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THE GOVERNMENT PURE SEED STATION.

OBJECTIVE AND WORK OF THE LINCOLN ESTABLISHMENT.

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INVESTIGATIONS on seed production were commenced by the Department of Agriculture in 1927, and during the initial stages facilities were afforded by the Fields Division on its Experimental Farm at Ashburton. When this farm was closed in 1931 the seed-production work was transferred to its present location at Lincoln. Since then the Canterbury Agricultural College has assisted most liberally in every possible way.

The Government Pure Seed Station comprises 52 acres of land leased by the Department of Agriculture from the Canterbury Agricultural College. It has been established with the definite objective of raising nucleus lines of high-quality seed for distribution to farmers, and the investigation of problems connected therewith. The land is flat and of a comparatively even nature, consisting of a heavy loam overlying a sandy clay. Immediate requirements have been met by the erection of a combined barn and workroom, and water and power have been laid on.

The farm is compact in shape and has been subdivided into four areas of 11 acres each, and one of 8 acres. The four large areas are worked under a four-course rotation as follows: Cereals, potatoes, peas and linseed, green manure and fallow. The remaining 8 acres has also been subdivided into four sections, and is worked under the same rotation. These small areas are used for the numerous trial plots connected with the work.

This rotation is probably open to criticism, but has been adopted only after the most careful consideration. It affords ample time for a thorough preparation of the land between each crop, and the elimination of self-sown material which inevitably arises however carefully the crops are harvested. Italian rye-grass has been chosen as a green manure, since it is a good smothering crop and is unlikely to introduce or perpetuate diseases which might affect the seed crops.

A determined attempt is made to eliminate disease, and no material which might be a source of infection is introduced on to the farm.

The College authorities have kindly co-operated in this by making available small isolation areas, where material which could not be introduced on to the farm can be grown under observation for a season.

Crop Improvement.

Growers are becoming more and more discriminating in regard to the purchase of agricultural seeds. Impaired germination, inadaptability of the variety or strain, seed-borne diseases, and inherently low vigour are all contributory factors rendering seed unproductive. The realization of these facts, more particularly those relating to strain differences, is one of the outstanding features of modern agriculture.

The average farm crop is regarded by the plant-breeder as a collection of individual plants which are not all alike. In this mixed population variations in height, yield, maturity, seed, and many characters of this kind can be detected, and they form a basis for selection. In attempting any improvement within a variety the individual plants have first to be studied to determine what promising variants are present, and these are then increased and tested.

This preliminary study of the crop, entailing the isolation and investigation of its component strains, occupies a considerable amount of time and necessitates extensive plot work of a technical nature. So far, investigations at the Pure Seed Station have been confined mainly to those varieties which have proved themselves under New Zealand conditions, but having explored all possible avenues in this direction further advancement will entail the introduction and testing of varieties from other countries, and finally the crossing of selected individuals, having in view some definite objective. The stage is approaching when further development in certain crops will necessitate the application of more advanced methods.

These introductory remarks will serve to convey an idea of the objectives in view. In some crops, notably potatoes, wheat, and barley, seed is being distributed annually; in peas and linseed this stage is about to be reached; simultaneously other crops are being studied which will, in due course, follow along similar lines.

The value to the farming community of the seed distributed each year would be very much less were it not for the system of seed certification undertaken by the Fields Division. Seed which is distributed by the Pure Seed Station is grown by farmers under certification. This ensures careful inspection of the farmer's crop, and the sealing and tagging of his produce. Ever-widening distribution is thus effected, and full benefit is derived from the nucleus seed distributed each year.

Since each crop offers problems of its own, a few comments on the individual crops will convey an idea of the work accomplished and the major difficulties encountered.

POTATOES.

The potato crop of New Zealand requires annually over 15,000 tons of seed. The position in 1927 was extremely unsatisfactory in that varieties were mixed and many of them wrongly named. The first essential, therefore, was to define varietal differences and clear up a great deal of the misunderstanding that existed. Most of these

difficulties were removed during the first year's work, and to-day the varietal position may be considered quite satisfactory. Constant attention to seed stocks is still necessary, however, if the present standard of varietal purity is to be maintained.

During the same year seed-potato certification was inaugurated and the attendant trials laid down. For the first time was then realized the very great loss experienced by the New Zealand grower as a direct result of virus diseases. Evidence was obtained of the transmission of these diseases from plant to plant in the field and from year to year by means of infected tubers, and thereafter potato selection work was directed more specifically to the isolation and multiplication of relatively virus-free lines.

Since 1927 over one hundred varieties have been grown and studied. The bulk of these proved to be of no commercial value, and by a process of elimination the number of varieties now being grown for distribution has been reduced to twelve. A further twelve are still under trial, their commercial possibilities not having been finally decided. This rapid elimination has been facilitated by the variety trials undertaken by the Fields Division, seed for which was supplied by the Pure Seed Station. A number of importations have been made, and of these Arran Banner has outyielded all other varieties in its class, and has exhibited a wide range of adaptability. This outstanding variety is likely to become extremely popular, and there has been a very heavy demand for seed raised at the Station.

Problems have arisen from time to time during the progress of the work. For example, many potato varieties produce a peculiar form of sport commonly called a "bolter." Such plants are taller, later, and more vigorous, and the tubers are larger and coarser, than those of the variety from which they arise. Bolting has presented a problem because, consciously or unconsciously, growers have sometimes selected these in preference to the parent type. The Epicure crops of New Zealand are dominantly bolters, and it has been necessary in several instances to determine the commercial possibilities of such forms. That they may be of outstanding merit is proved when we consider that Auckland Short-top, which is the most popular variety in New Zealand to-day, is a bolter from Sutton's Supreme. Similarly Aucklander Tall-top, a bolter from Aucklander Short-top, is the latest and one of the heaviest yielding varieties grown in this country.

The problem of raising virus-free seed has developed complications as the work has advanced. Plants affected with virus disease usually exhibit visible symptoms on the foliage, associated with a serious diminution in yield. Aphids transmit certain of these diseases from plant to plant in the field, and infection is maintained from year to year primarily through the use of infected seed. Avoidance of these diseases offers the only solution, and the first step in selection work has been to search for plants that appear free from infection. The produce of these is then multiplied under conditions which will reduce to a minimum the possibility of infection from outside sources.

Leaf-roll is the most common virus disease in New Zealand, and the loss from this cause alone is very serious. Fortunately, avoidance

has proved relatively simple, and the stocks offered by the Station are quite satisfactory in this respect. Mild mosaic has also offered very little difficulty. Despite all precautions, however, by rogueing, and by planting nothing but the produce of what appear to be disease-free plants, a few severely virus-infected plants continue to appear. Certain peculiarities characterize the appearance of these plants. They appear as severely diseased individuals in a crop which is otherwise healthy and vigorous; they arise suddenly from no apparent source of infection; the range is more or less restricted, and the disease is not found commonly in commercial crops; and, finally, only certain varieties are affected.

FIG. I. PORTION OF SEED POTATO AREA AT THE GOVERNMENT PURE SEED STATION.

The crops are examined at regular intervals, and every diseased plant removed as soon as it is observed.

Research workers in potato virus diseases have proved that certain varieties are carriers of infection but do not themselves exhibit any symptoms. This being the case, two apparently healthy varieties growing near one another may be a source of infection to each other, and one or both may exhibit virus disease the following season. Such infection causes, in many cases, a very severe form of virus, which may even result in the death of the plant.

This discovery necessitated a complete revision of the methods being adopted at the Station, and seemed to explain the sudden appearance of virus disease in certain of the lines. Up to this time the practice had been to select large tubers from plants which appeared healthy, to cut each tuber into four parts, and plant these as a tuber unit. Every tuber unit showing signs of disease was at once removed and the remainder harvested. The produce was multiplied in short rows, and from there to larger blocks, until sufficient material was

available for distribution. Dealing with a number of varieties, and growing the tuber units together, later the short rows together, and so on, step by step, it will be realized that ideal conditions were afforded for transmission of virus from one variety to another. With fuller knowledge of the problems relating to the carriers of these diseases, it is now almost certain that the planting system was at fault and had been the cause of virus disease manifesting itself from no apparent source.

The first precaution taken was to grow all tuber units in small isolation plots in a crop of oats. This resulted in such marked improvement as to warrant an attempt to isolate as far as possible one variety from another through each stage of multiplication. The system now adopted is to plant the tuber units and small increase plots of any variety within the larger increase blocks of that variety, situating these plots preferably on the windward side. This ensures that the increase plots are removed as far as possible from any other variety. Moreover, each series of plots is separated from the others by strips of oats or blue lupins, and where the increase block adjoins that of another variety a wide strip of some buffer crop is grown. This is not regarded as completely effective in checking the spread of the disease, but it does in practice afford a check to the migration of those insects which are in a great measure responsible for the distribution of virus.

Despite these difficulties a large quantity of high-class seed has been sold during the last few years. Purchasers have expressed every satisfaction, and last season the Station received orders far in excess of what could be produced, and at a figure well above the current market price. These nucleus lines finding their way to growers who enter their crops for certification is certainly tending to raise the general standard of our potato crops.

The Station also renders a service in growing varieties for identification. Samples are received from all parts of New Zealand. These are grown and reports furnished upon them. To assist in this work, and for educational purposes, a collection of all available named varieties is maintained at Lincoln College, quite apart from the pure seed production at the Station.

WHEAT.

Seventy-five per cent. of the wheat acreage in New Zealand and 85 per cent. of that in Canterbury is devoted to Solid-straw Tuscan. Seed of this variety is remarkably pure. The other varieties, representing 25 per cent. of the wheat area, were for the most part in a very mixed state in 1927. Since then pure lines of all standard varieties have been raised and distributed. Thus an annual supply of pure seed is available. Future work will consist of making, each year, single plant selections within the pure lines, and multiplying these till they reach a sufficient bulk for distribution. It is not intended to develop beyond this stage. All wheat-breeding is undertaken by the Wheat Research Institute, and the part played by the Station consists in maintaining a supply of pure seed of standard varieties or of new varieties raised by the Institute.

Natural crossing in wheat has presented a difficult problem. Wheat is normally self-pollinated and therefore it should be possible for two varieties to be grown in adjoining plots without serious danger of crossing. In Canterbury hot winds at pollinating time are probably responsible for the flower opening either earlier or to a greater extent than is normally the case, and receiving pollen which is liable to be scattered some distance under these conditions.

It has been shown that natural crossing decreases very rapidly as the distance between the varieties is increased. The somewhat extensive cross-pollination that has been observed from time to time in the pure lines has undoubtedly taken place in the nursery rows, when varieties have been grown in close proximity to one another. To overcome this danger all nursery rows and small increase plots

FIG. 2. SEED WHEAT PLOTS AT THE STATION.

Between each plot is a belt of rye-corn, which, being taller than the wheat, helps to prevent cross-pollination of the varieties.

of any one variety are now grown in the centre of the main block of that variety. Thus any natural crossing is almost certain to be within the variety. Where the boundary of one variety meets that of another a belt of rye-corn 12 ft. wide is grown. This attains a greater height than the adjoining wheat and, by arresting wind-borne pollen, is sufficient to render negligible any intervarietal crossing.

The control of covered smut has offered no difficulty. Loose smut, on the other hand, has proved more difficult to control than was at first anticipated. The Station is indebted to the Canterbury Seed Company, Christchurch, for undertaking the hot-water treatment of all seed wheat. With few exceptions this has resulted in smut-free crops. Occasionally, however, a small source of infection has been overlooked. In one instance a few infected

heads developed in a plot of wheat 20 chains distant, and the following season a number of varieties were observed to be infected.

The timely realization of the possibilities of such a wide distribution of spores enabled extra precautions to be taken, one of which is that all seed sown in the final increase blocks is hot-water treated, ensuring that seed wheat distributed by the Station is never more than once removed from treatment. Apart from the small risk of outside infection during the growing season, this ensures the distribution of smut-free seed.

PEAS.

The area annually devoted to the production of peas in New Zealand fluctuates between 10,000 and 20,000 acres. The crop is practically confined to Canterbury and Marlborough.

Certain of our merchants specialize in the production of garden peas, which are grown on contract with farmers. Since the seed is generally supplied to the grower under a code letter or number, he is not particularly interested in the matter of purity and correct nomenclature. The merchant, on the other hand, is vitally concerned with varietal purity. Few seeds are subject to such close scrutiny, and a high standard has to be maintained or very serious consequences may result. Impurities may be introduced during threshing, harvesting, and seed-cleaning; but, quite apart from these causes, off-type plants or "sports" arise and multiply very rapidly unless discovered in the field and removed. The occurrence of these impurities necessitates rogueing in the field, and men are employed to walk up and down the crops to remove all rogue or off-type plants. Rogueing is very expensive, and is not as effective as might be desired.

The selection work at the Station has a twofold objective. It is desired, firstly, to raise pure lines as nearly characteristic of the variety as is possible; and, secondly, to sell to merchants each year a few sacks of pure seed of each of the more important commercial varieties.

The first objective is not as simple as it might appear. Difficulty was experienced in arriving at the true types representative of certain of the more popular varieties. For example, single-plant selections from such varieties as Daisy and Stratagem varied considerably, and no standard could be obtained upon which to base selection. This indecision resulted in considerable delay, and in some cases divergent types have been maintained pending a decision. Thanks to the co-operation of merchants, practically all these lines are being grown, both in New Zealand and England, by those well versed in trade requirements, and their criticisms will be invaluable in arriving at a decision as to which lines to retain and which to discard.

The second objective is really a commercial one. Merchants supply stock seed to growers, and after a few years it reaches a state of impurity that necessitates rogueing. Were merchants to procure annually a few sacks of pure seed they would be able to multiply and distribute this to their growers. Since each year

under this scheme they would have pure seed coming forward, they would be in a position to discard stocks which had become impure, and in this way avoid, wholly or in part, the expensive operation of rogueing. Preliminary selections were made in 1928, and this season pure stocks of about thirty varieties are being grown. It is hoped to make contracts this season for delivery in 1933–34, and several merchants have indicated their intention to procure seed from the Station.

Selection work in field peas was also commenced in 1928. After preliminary trials numerous lines were isolated from the standard varieties. These have been placed under trial each year, and by a process of elimination the number has been so reduced that during the last two seasons careful yield trials have been possible. Progress has been slow, partly because of seasonal conditions and partly on account of inadequate knowledge of those characters upon which to base selection. For example, the Partridge pea is the most important variety, and is grown either for seed which is consumed in this form, or as a fodder or green manure. For the former purpose certain seed characters are desirable, and also a heavy yield associated with the minimum of haulm. For fodder and green manure purposes bulk is of importance, and seed yield, though desirable, is not so essential. Two specialized types, rather than one with a dual purpose, seem to be desirable. Blue Prussians, White Ivory, and Marrowfat peas are also receiving attention, and some very promising selections have been made.

LINSEED.

The Moose variety of linseed is an introduction from Algeria, known there under the name of Lin de Safi. It has been grown for a number of years in New Zealand, and the yields have proved satisfactory and the content of oil appreciably higher than that of the commonly grown variety. It has, however, a very short straw, which renders harvesting with the reaper and binder very difficult. A number of selections were therefore made of tall plants growing in commercial crops. By this simple means tall strains have been isolated, and these are now undergoing final yield trial and analysis to determine which should be retained for increase.

Numerous varieties have also been introduced, but now, after several years' trial, all but a few of the most promising have been discarded. These few are being included in the current season's trials.

CONCLUSION.

It takes several years to establish work of the kind described, but results are now forthcoming and fully justify the establishment of the Pure Seed Station. It will be still further justified as additional crops are added to the programme of work. Objectives which at one time were somewhat nebulous have assumed more definite form, and the work will progress along surer lines in the future. The purpose of this review will have been attained if it brings the Station and its objectives under the effective notice of farmers, merchants, and those engaged in agricultural instruction.

OFFICIAL HERD-TESTING OF PUREBRED DAIRY COWS.

SUMMARY OF THE SEASON'S WORK, 1931–32.

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THE Official Herd Test has now completed its fifth year of operation, and at the close of the year under review—30th September, 1932—some 8,856 cows had been tested under this system. Under ordinary circumstances a survey of the five years' results would have been interesting, but the abnormal conditions experienced during the past two years or so tend to make such a review practically valueless.

So far as the past year is concerned, the position must be considered satisfactory, as, while there was a falling-off, the proportion of O.H.T. breeders and tested cows to number of entries in the parent system, the Certificate-of-Record Test, was more than maintained. For the twelvemonth ended 30th September last 1,798 cows were tested under the O.H.T. system, these being in the herds of 160 of C.O.R. testing breeders. This represents a decrease of 438 cows and 15 breeders from the 1930–31 year. All breeds, and particularly the Friesians, showed a decided falling-off, the only breed to improve its position being the Milking Shorthorn.

The accompanying tables are compiled on the basis of all cows on test for six months (180 days) or more, which has proved to be the most satisfactory classification, the O.H.T. being a ten-months test. Cows other than registered purebreds are omitted from the

Table 1.—Official Herd-testing in Two Past Seasons on Basis of all Cows on Test for 180 Days or more.

Breed.	Number of Breeders.	Number of Cows.	Average Yield for Season.		
			Days in Milk.	Milk.	Butterfat.
Season 1930–31.					
				lb.	lb.
Jersey	134	1,187	283	5,851·7	314·26
Friesian	27*	632	274	8,256·8	286·42
Ayrshire	3	42	273	6,765·0	266·45
Milking Shorthorn ..	5	128	257	5,789·5	231·09
Red Poll	1	19	268	5,168·2	206·14
Totals ..	170	2,008	278	6,617·4	298·17
Season 1931–32.					
Jersey	121	998	284	5,704·2	307·73
Friesian	20*	279	274	7,518·2	262·92
Ayrshire	4	37	260	6,462·3	273·96
Milking Shorthorn ..	11	174	274	6,039·7	243·41
Red Poll	2	18	268	4,926·3	204·57
Totals ..	158	1,506	280	6,088·4	289·94

* One Friesian breeder also testing Jerseys.

Table 2.—Average Production in Classes and Breeds for all O.H.T. Cows.

Class.	Season 1930–31.				Season 1931–32.			
	Number of Cows.	Average Days.	Average Milk.	Average Butterfat.	Number of Cows.	Average Days.	Average. Milk.	Average Butterfat.
				Jersey.				
			lb.	lb.			lb.	lb.
Two-year-old and under	488	282	5,111·8	275·65	403	286	5,126·8	277·24
Three-year-old	174	274	5,708·9	310·32	191	283	5,774·6	315·63
Four-year-old	159	286	6,434·7	350·37	130	286	6,226·7	337·93
Mature	366	287	6,652·6	351·92	274	282	6,256·6	332·76
				Friesian.				
Two-year-old and under	207	280	6,978·3	246·14	85	280	6,116·9	217·61
Three-year-old	106	269	8,196·8	287·79	60	273	7,763·3	270·02
Four-year-old	88	266	8,394·6	291·46	40	275	8,035·6	281·13
Mature	231	273	9,377·5	319·96	94	268	8,408·8	291·60
				Ayrshire.				
Two-year-old and under	2	263	5,246·4	223·16	9	234	5,649·5	220·96
Three-year-old	13	273	6,634·6	258·71	2	233	5,522·2	241·66
Four-year-old	8	264	6,949·0	272·09	11	256	6,754·0	275·49
Mature	19	277	6,936·6	273·92	15	280	6,861·5	308·93
				Milking Shorthorn.				
Two-year-old and under	42	258	4,560·2	184·80	53	275	4,850·2	198·83
Three-year-old	20	266	5,781·2	240·01	34	268	5,753·4	231·67
Four-year-old	11	256	6,922·9	274·86	19	273	6,600·1	267·96
Mature	55	253	6,504·5	254·44	68	277	6,953·4	277·16
				Red Poll.				
Two-year-old and under	5	275	4,452·1	198·17	8	283	4,937·4	199·05
Three-year-old	6	265	4,729·5	187·82	6	239	4,538·0	196·09
Four-year-old	5	271	6,019·3	224·81	3	274	5,321·7	225·66
Mature	3	261	5,820·7	225·01	1	299	5,980·3	236·34

tables, although each year a number of these are tested by special arrangement where no other organized system of testing is reasonably available or where the unregistered cows form only a small proportion of the herd. Some 95 cows came under this heading, while 186 registered purebreds and 11 other cows were, for various reasons, withdrawn from test prior to 180 days and consequently did not qualify for inclusion in the tables.

Table 1 is a production table, according to breed. In view of the unfavourable climatic conditions, an average yield of 289·94 lb. of butterfat must be considered satisfactory in comparison with the preceding year's average of 298·17 lb. Both Ayrshires and Milking Shorthorns show increases, the latter breed having improved its position very creditably in both average production and number of cows tested.

In Table 2 the production averages are given under age classes within the various breeds, the previous year's figures being included for purposes of comparison.

It is interesting to compare the O.H.T. results with those for ordinary factory-supply herds. New Zealand's average tested cow for last season, including all cows in milk 100 days or more, yielded 236 lb. butterfat in 253 days. The O.H.T. average on the same basis was 280·12 lb. in 271 days, while the C.O.R. 305-day test average was 421·09 lb., and the 365-day test 495·17 lb.

WOODLANDS FELICIE QUALIFIES FOR CERTIFICATE OF RECORD.

THE Jersey cow Woodlands Felicie, whose world record performance was reviewed in detail in the *Journal* for September last, calved subsequent to test on 2nd November. The calf is a heifer, born 441 days after the dam's date of calving for commencement of test. Thus Woodlands Felicie has now fully qualified for her first-class Certificate of Record, the maximum period allowed for calving under the rules for the first class being 455 days. Woodlands Felicie had her first calf on 30th August, 1928, and her succeeding dates of calving were 8th October, 1929, 12th July, 1930, 19th August, 1931, and now 2nd November, 1932. In addition, therefore, to being a wonderful producer of butterfat Woodlands Felicie has been a consistent breeder. It may be again mentioned that her final figures for the 365 days on test were 1,220·89 lb. of butterfat from 17,332 lb. of milk, and that the test was commenced at the age of 4 years 364 days.

As previously stated, Woodlands Felicie is owned by Mr. P. J. Petersen, of Brixton, Waitara, Taranaki. While this cow's productive ability has been amply demonstrated by her world record performance, it is obvious that she has received kindly and skilful treatment. Our congratulations are extended to Mr. Petersen.

—Dairy Division.

SCLEROTIUM-DISEASE *(SCLEROTINIA SCLEROTIORUM)* OF TOMATOES.

ITS APPEARANCE, CAUSE, AND PREVENTIVE TREATMENT.

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SCLEROTIUM-DISEASE (also variously known as sclerotinia-disease, sclerotial-disease, stalk-disease, &c.) is in New Zealand a serious disease of tomatoes, especially of those grown out of doors. The disease is of world-wide distribution, and has been recorded as occurring on tomatoes throughout Europe, North America, and Australia. It was recorded as occurring on tomatoes in New Zealand by Kirk (1906), who in the same year also recorded it on potatoes, beans, and chrysanthemums.

SYMPTOMS.

The first sign of sclerotium-disease is usually a sudden wilting of the plant when it is in the four or five truss stage—*i.e.*, just as it is coming into bearing. At some point below where the plant is wilted a light-coloured portion of the stem may be seen (Fig. 1). This pale-coloured area marks the limits to which the causal organism has penetrated.

Under New Zealand conditions infection usually takes place at the nodes and at some distance above the ground-level. Occasionally, however, the plants are infected at the ground-level. The disease spreads rapidly through the tissues, blocking the vessels and cutting off the water-supply, with the result that the plant wilts and soon dies. This disease is typically a disease of the stem, and the causal organism confines its attack to this part of the plant, the leaves being killed merely by starvation.

On splitting open the discoloured portion of the stem it is found to be lined with irregularly shaped black bodies ranging in size from that of a grain of wheat to that of a pea (Fig. 2). They are hard and tough, and on being cut are seen to be white inside. The presence of these black bodies within the stem is the most characteristic feature of the disease. Any fruit which is already formed at the time of the attack shrivels up. In normal seasons when the attack is not severe it is usual to find infected plants scattered here and there throughout the field, but when the disease is prevelant infection usually occurs in patches.

ECONOMIC IMPORTANCE.

Sclerotium-disease occurs in both North and South Islands, and has been recorded from every district where tomatoes are grown. It is one of the most serious diseases attacking tomatoes in this country. A small proportion of plants are attacked every year, while in certain years it occurs in epiphytotic form. It is of sporadic occurrence, being prevalent in one district while in a neighbouring district very little of the disease may be present. It occurred in epiphytotic form on various hosts in the years 1919, 1923, and 1927, being particularly severe on tomatoes in 1923.

The plants attacked are killed, and as a rule the attack takes place too late in the season to allow of a profitable replacement with fresh

FIG. 1. SCLEROTIUM-DISEASE ON TOMATO PLANT.

Light-coloured area indicated by arrow shows the point of attack by the fungus at a node.

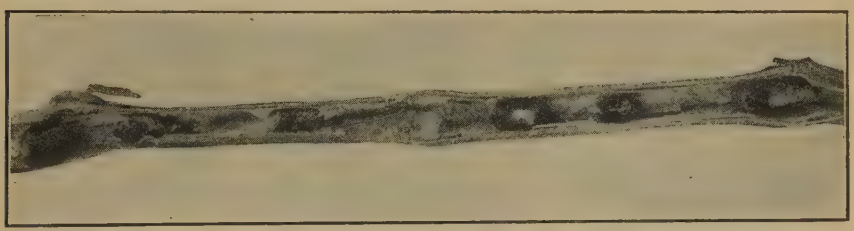

FIG. 2. SCLEROTIA LINING THE PITH CAVITY OF A TOMATO STEM.

[*Photos by H. Drake.*

plants. Although sclerotium-disease is more serious among outdoor tomatoes, it may become quite a serious problem in the glasshouse. Over 30 per cent. of infection was recorded in one glasshouse in Christchurch in 1923. The disease is more severe in unheated than in heated houses.

Host Range of the Causal Organism.

This disease is not confined to tomatoes, but attacks a wide range of plants. In other countries it causes serious losses among many crops, and is also responsible for serious storage rots. It is one of the most serious diseases occurring on garden crops in this country and is particularly severe among artichokes, lettuce, and potatoes. Cunningham (1927) gives the following list of plants attacked by the causal organism in New Zealand: Antirrhinum (cultivated), artichokes (Jerusalem), bean (broad or Windsor, butter, French, horse, soya), brassicas

(chou moellier, cabbage, kale, rape, swede, and turnip), carnation, Cape gooseberry (*Physalis peruviana*), Canadian thistle (*Cnicus arvensis*), carrot, celery, cucumber, curled dock (*Rumex crispus*), dahlia (cultivated), fat-hen (*Chenopodium album*), fennel (*Foenicilum vulgare*), lettuce, lemon (fruits and shoots), mangold, melon, potato, pea, parsnip, pelargonium (cultivated), passion-fruit, spear thistle (*Cnicus lanceolatus*), sweet-pea, sunflower, spinach, tomato, tree mallow (*Lavatera arborea*), tree tomato (*Cyphomandra betacea*), tulip, and wing thistle (*Carduus pycnocephalus*).

Brien (1932) has made the following additions to this list: Apple (fruits in cool store), bitter cress (*Cardamine heterophylla*), blue lupin, larkspur, lucerne, marrow, milk thistle (*Silybum marianum*), orange (fruits), pear (fruits), pumpkin, radish, sow thistle (*Sonchus oleraceus*), tobacco, wallflower, and zinnia.

Life History of the Causal Organism.

The causal organism is the same as that described by Cunningham (1927) as causing a disease of Jerusalem artichokes—namely, *Sclerotinia sclerotiorum* (Lib.) Mass., an organism which has in North America been usually named *S. Libertiana* Fcl.

Doubt exists in literature as to the mode of infection by this fungus. Working on this disease de Bary (1886: 1887) came to the conclusion that it was necessary for the fungus to pass through a previous stage as a saprophyte before it could function as a parasite. Pethybridge (1911) showed that although the spores were not able directly to attack normal healthy leaves of potatoes, they were able to attack leaves which had begun to yellow off. Field observations indicate that this is the case with both potatoes and tomatoes under the conditions existing in New Zealand. That the fungus may directly attack healthy tissue has been shown by successful inoculations of the stems of healthy tomato and potato plants with portions of sclerotia and with mycelium secured from culture.

The life history of *S. sclerotiorum* has been described by Pethybridge (1910: 1911) and its mode of infection by Boyle (1921). Given sufficient moisture the spores of the fungus germinate and send out germ tubes. If any of these germ tubes come in contact with a yellowing leaf they send out narrow infection hyphæ, which are capable of rupturing the cuticle by mechanical means and entering the leaf. If, on the other hand, the germinating spore is not in the vicinity of a yellowing leaf the germ tubes either do not develop beyond the rudimentary stage or, if they are in the presence of decaying organic matter, they form a saprophytic mycelium. This saprophytic mycelium is capable of forming infection hyphæ which can penetrate and infect any tomato leaf or stem with which they come in contact. Field observations show that in many cases infection occurs from the fungus growing in the soil, for it has been noticed that leaves touching the ground at their tips often become infected. Moreover, occasional plants become infected at the ground-level, and in these cases the infection has probably occurred from the fungus in the soil.

Having gained entrance to the leaf the hyphæ develop a mycelium which rapidly spreads through the leaf and down the leaf petiole to the stem. The fungus rapidly girdles the stem, disorganizing the

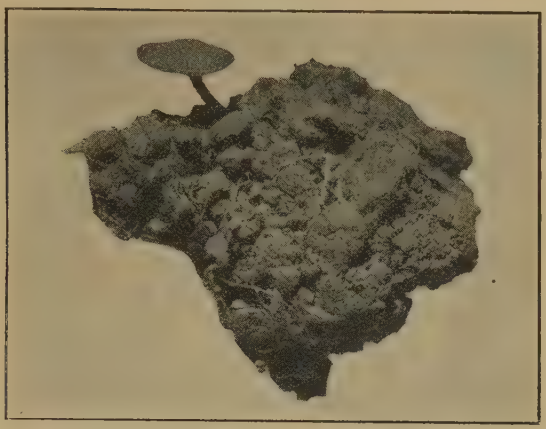

FIG. 3. APOTHECIUM OF SCLEROTIUM-DISEASE × 1½.

Collected from the field and showing the apothecium growing from a sclerotium embedded in the soil.

FIG. 4. APOTHECIA PRODUCED IN CULTURE GROWING OUT FROM SCLEROTIA × 1½.

[Photos by H. Drake.

tissues and preventing the passage of water, with the result that the plant wilts. Not only does the fungus kill the outer portions of the stem but it penetrates to the interior, where it replaces the pith with a white mycelium. Portions of this mycelium become compacted into closely interwoven dense masses of hyphæ (sclerotia), which ultimately line the pith cavity (Fig. 2). They are at first white, but finally turn black at the surface. If the conditions are very humid they are also formed on the outside of the stem.

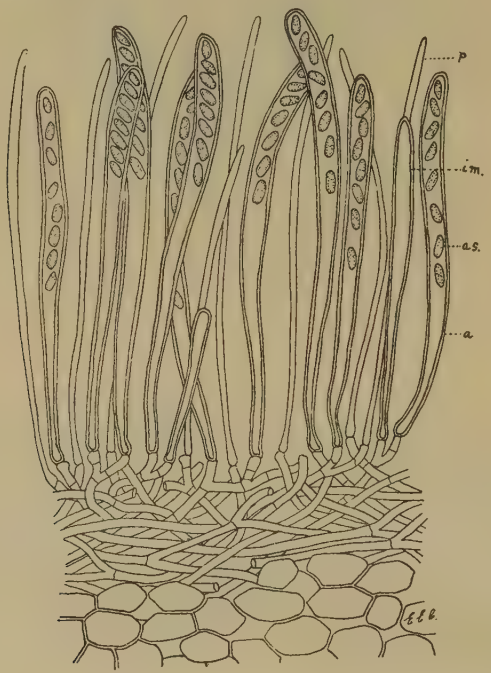

FIG. 5. SECTION THROUGH APOTHECIUM × 430.
(*a*) Asci; (*im.*) immature ascus; (*as.*) ascospores; (*p*) paraphyses.
[*Original.*

When the plant dies down the stems rot away and the sclerotia find their way into the soil, where they are capable of remaining viable for at least two years (Baribeau, 1923). Under New Zealand conditions the sclerotia kept in a dry state were found to be viable after two years and a half. In the spring and early summer, under suitable conditions of temperature and humidity, they will germinate and produce light-coloured, stalked, cup-shaped bodies termed apothecia (Figs. 3 and 4). On the upper surface of these bodies occur long cylindrical sacs (asci) each of which contains eight spores (ascospores) (Fig. 5). These spores are ejected from the apothecia and may be carried by the wind to neighbouring plants and soil. The apothecia are produced over a period of several months, and the spores may remain viable for as long as forty-five days (Lobik, 1928).

FACTORS AFFECTING INFECTION, GROWTH, AND SPREAD OF SCLEROTIUM-DISEASE.

As with most fungi, moisture is essential for the germination of the spores. Infection may take place either through the yellowing leaves or from the soil in close proximity to the plants, so that only those spores germinating in these positions are significant in spreading the disease. The older leaves yellow off first, so that high humidity at the base of the plants will not only encourage germination of and infection by spores on the surface of the ground but also of those on the leaves. High humidities are mainly due to the prevailing climatic conditions, but are considerably influenced by close planting, the presence of weeds and other cover on the surface of the ground beneath the plants, and by the presence of abundant foliage at the base of the plants.

Apothecia develop only under conditions of favourable soil temperature and humidity. Compacted soil and the presence of cover on the surface tend to raise the soil humidity, and it is very noticeable that it is under these conditions that apothecia are usually formed. They are rarely formed on well-cultivated friable soil, since a compacted soil with a resultant high moisture content in contact with the sclerotium is necessary for its germination. Sclerotia occurring on the headlands readily produce apothecia under cover of grass and weeds. Not only is high humidity necessary for the production of apothecia and for infection by the spores, but it also produces a much more rapid growth of the fungus within the tissues. If the conditions are very humid an increased number of sclerotia are formed, for they are then produced on the outside of the stem as well as inside.

The optimum temperature for the growth of the fungus is not high, and its attack is most severe between 60° and 70° F. (Weber and Foster 1928). Thus the disease is more common and more troublesome in unheated than in heated glasshouses.

The spores of the fungus are ejected from the apothecia for some distance into the air, and may be carried considerable distances by the wind. Thus a garden may be free from sclerotia and apothecia and still become infected from neighbouring fields. Smith (1931) considered that under the conditions existing in California the spores were always present, whether any apothecia occurred in the field or not, and that infection depended solely on climatic conditions. Although it is not probable that the spores are quite so numerous in New Zealand, it may readily be seen that it is dangerous to leave infected plants bearing sclerotia lying about the headlands or on rubbish heaps in or near the gardens.

Not only is there a danger of the disease being carried over from one season to the next by sclerotia from an infected tomato crop, but the sclerotia formed on any one of the numerous susceptible hosts may also serve as a source of infection. In this connection the growing of blue lupins for green manuring may become a factor in spreading the disease. Blue lupins are susceptible to the attack of sclerotium disease, and where it is present in the crop the seed often becomes infected and in some cases the seeds are actually replaced by sclerotia

FIG. 6. LUPIN SEEDS REPLACED BY SCLEROTIA WITHIN THE PODS.
[*Photo by H. Drake.*

(Fig. 6). Thus there is a possibility of introducing the disease into a garden when this cover crop is used. The disease is also carried in the seed of sunflowers and on the tubers of artichokes.

Preventive Measures.

From the foregoing it may be seen that infection is brought about by the ascospores, so the obvious method of checking the disease would appear to be by killing the spores. Since the apothecia may be produced by sclerotia in any part of the garden, or even in a neighbouring garden, it is not possible to destroy the spores at their seat of origin. It is reasonable to suppose that infection through the yellowing leaves might be prevented by spraying, but even if this could be accomplished infection from the soil could not be controlled by this means. Pethybridge (1916) showed that spraying with bordeaux, lime-sulphur, or milk of lime had no effect on the incidence of the disease on potatoes. It may be concluded that sprays cannot be satisfactorily used against sclerotium-disease.

Since it does not seem to be possible to actually destroy the spores an attempt must be made to prevent the introduction of the disease into the garden, or, once it is there, to prevent the development of apothecia. The disease may in many cases be introduced into a garden by air-borne spores, and this type of infection cannot be prevented. It is not feasible to destroy the sclerotia present in the soil of a garden, since any treatment which would kill the sclerotia would be too expensive to apply.

Although crop rotation may help in keeping down infection, it must be remembered that the planting of tomatoes on clean land does not ensure freedom from infection if sclerotia are present in an adjacent field.

Control in the Field.—The plants should be well spaced and a judicious pruning of the lower leaves practiced. The lowering of the humidity resulting from the greater air circulation and better penetration of the sun's rays will check germination of the spores, and consequently lower infection. The ground between the plants should be well worked and all weeds and other cover removed. This will also aid in keeping down the humidity, and the loosening of the soil will prevent the development of apothecia. Thorough cultivation is one of the most important factors in keeping down infection by this fungus.

Care should be taken to see that the disease is not introduced into the garden in infected seeds, and particular care should be taken when securing lupin seed for growing as a cover crop. The seed may be tested by throwing a few handfuls of it into water, when the sclerotia and the seed bearing sclerotia will float to the surface. Any suspicious bodies may be tested by cutting, when the fact that the sclerotia are white inside serves to distinguish them from other foreign bodies. When growing lupins the plants should be examined for the presence of the disease before they are dug in.

All diseased plants should be removed immediately they are seen, and care should be taken that no sclerotia are allowed to fall to the ground. The infected plants should be burnt and not piled up in rubbish heaps or left on the headlands, as the sclerotia are then in an ideal position for the production of apothecia. Not only is it necessary to destroy all the diseased tomato plants, but also the infected plants of any other crop.

Control in the Glasshouse.—Sclerotia in the soil may be killed by steam sterilization, and this is the method recommended for sterilizing the soil in an infected glasshouse. It is also advisable to sterilize all soil which is being introduced into the house. Where steam sterilization is not possible the soil of an infected house should be removed and replaced with clean soil. When resoiling the glasshouse the soil should not be taken from a garden where plants susceptible to the disease have been growing. The best practice is to obtain the soil from a field which has been down in grass for a number of years.

As in the field, the lower leaves of the plants should be pruned and the soil well cultivated. The humidity should be kept down by giving as much ventilation as possible consistent with the maintenance of an even temperature. The watering, which should not be excessive, should be carried out in the morning, and as far as possible on fine days only. Water should not be allowed to lie on the surface of the ground, for if sclerotia are present surface water will tend to bring about apothecia formation. Directly the disease is seen in the house all infected material should be removed and destroyed.

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WIRE-BRACING OF FRUIT-TREES.

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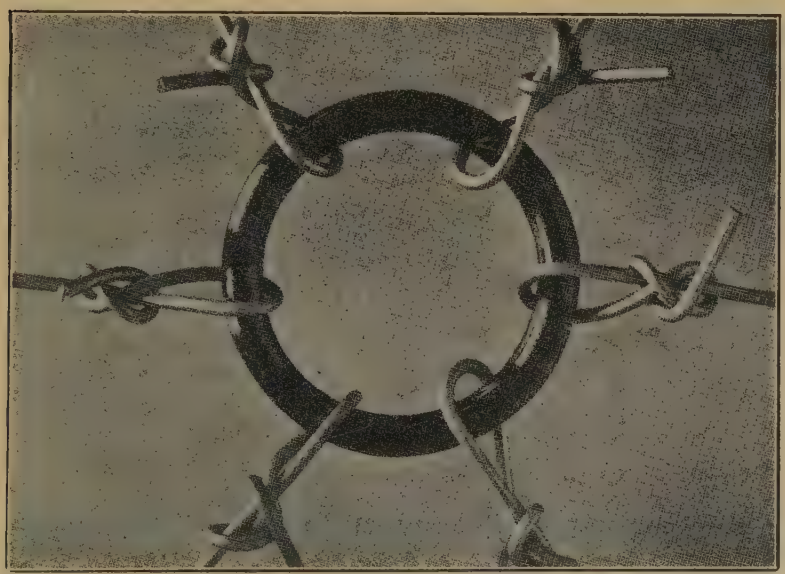
WIRE-BRACING for the support of limbs in fruit-trees is rapidly increasing in popularity in New Zealand and elsewhere, and is proving more satisfactory than wooden props and less costly. It is intended in this article to explain several of the different systems, and to make a comparison between "central" wire-bracing and the use of props.

One of the first systems brought into use in commercial orchards is known as the "cross" system of wire-bracing, and consists of connecting limbs on either side of a tree by a single strand of wire. The wire may be connected to the limbs in a number of different ways, such as (*a*) driving a staple into the side of the limb facing the centre of the tree and at the desired height, the wire being fastened to the staple; (*b*) inserting a screw-eye instead of a staple; (*c*) placing the wire round the limb and preventing it cutting into the bark by the use of a metal clip manufactured for the purpose, or by threading on to the wire a small length of old spraying hose, or using a piece of old motor-tire, &c.; and (*d*) boring a hole through the limb slightly larger than the diameter of the wire to be used, and after threading the wire through the hole turning the end back with pliers and again inserting it a small distance into the hole, the bulge made in bending the wire being thus too great to be drawn back.

While this system of wiring gives satisfactory results in some cases, it is not suitable to all trees, particularly trees that have a much more vigorous growth on one side than on the other, in which case the weakly branches are often pulled up into the centre of the tree through

lacking sufficient strength to support the larger limbs. Trees that have more limbs on one side than on the other also present difficulties in using the " cross " system of wiring.

The " circle " wiring-bracing system finds favour with a number of orchardists, and consists in placing a wire around each tree at the most desirable height, the wire being prevented from injuring the bark in the same way as in the " cross " system. One of the weaknesses of this method is that many limbs require support at a different height from the ground to others, which results in the shorter and weakly limbs being given a bowed effect, while the extra tall limbs are inclined to break off at the level of the wire.



SHOWING PROPER METHOD OF FASTENING WIRES TO RING IN CENTRAL BRACING SYSTEM.

This figure 8 tie is quick to make and is not liable to pull out like an ordinary twist.

The " central " wiring system has distinct advantages over the other two described. In this system each limb is supported by a wire, one end of which is attached to the inner side of the limb by means of a screw-eye or staple ; the other ends of the wires come together in the centre of the trees where they are attached to a single ring which is supported by the various wires. Rings suitable for this purpose are japanned malleable iron harness-rings, with a diameter of 2 in. and thickness of iron $\frac{1}{4}$ in. Large-sized washers could also be used. Screw-eyes that have been found suitable for limbs varying in diameter from 1 in. to 3 in. have a total length of $1\frac{1}{2}$ in. ; the " eye " should be $\frac{3}{4}$ in. (outside measurement) and the thickness of metal about $\frac{5}{32}$ in. For fastening the individual wires to the limbs a staple is very often used, the size varying according to the size of the limb. However, the

staple is more likely to split the branch than a screw-eye and thereby increase the risk of either pulling out or the limb breaking off under the weight of a heavy crop.

Any means of fastening which necessitates the wire encircling the limb should be avoided on account of the trouble in preventing the wire cutting into the bark as the diameter of the limb increases. Screw-eyes varying in size according to the diameter of the limb are therefore to be preferred, and should be screwed in until the shoulder of the eye meets the bark. The eye should be left parallel with the limb rather than crosswise, for if left crosswise it is liable to restrict the flow of sap in later years. Tall and slender limbs will in some instances require to be supported by two wires, both of which can readily be fastened to the centre ring. In other instances some of the smaller limbs are most economically fastened to the larger limbs.

While wiring can be done at any time of the year, the most suitable time is immediately after the winter pruning has been completed. At this time the limbs are not pulled out of position by the weight of fruit, there is no foliage to restrict vision or young shoots that are readily broken, and the rush of work is not usually so great as later in the season.

Central wire-bracing has the following advantages over wooden props: The bracing is practically permanent, lasting, it is estimated, at least twenty years; it can be done at almost any season of the year; the cost of material is cheap and depreciation very low; it does not interfere with picking and carting of fruit, spraying or cultivation; the strain on any one limb is supported by all limbs, and the limb is secure during any storm.

The principal disadvantages of wooden props are high cost and high depreciation; inconvenience caused in picking and carting the fruit, interference with cultivation and spraying, and frequent dislodgement by wind, &c., allowing the branch to break.

For the purpose of making a comparison between the cost of central bracing and props the following figures have been worked out, which, it is believed, give a fair and reasonable estimate. While prices may vary considerably in different districts, the quotations (secured in June, 1932) afford a basis for estimating the cost of materials.

Estimated Annual Cost per Propping of 100 Trees, allowing Support for Ten Limbs per Tree.

	£	s.	d.
1,000 manuka props 6 ft. to 8 ft. long at £2 10s. per 100, allowing life of props at 5 years (cost per year)	5	0	0
Placing in position each year (labour)	2	0	0
Annual removing from orchard and stacking (labour)	1	0	0
Total	8	0	0

Estimated Cost of Central Wire-bracing per 100 Trees, allowing Support for Ten Limbs per Tree.

	£	s.	d.
100 harness rings at 15s. per gross	0	10	6
1,000 galvanized screw-eyes, 1½ in., at 4s. per gross	1	7	9
Galvanized wire, 14 gauge, at 4 ft. per limb, reckoning 6,560 ft. per cwt. and wire at 30s. per cwt.	0	18	3
Labour required to secure screw-eyes and wires to 100 trees, assuming that one man at 12s. per day can wire 24 trees	2	10	0
Total initial cost of wiring	5	6	6

Assuming that the life of a wiring system is but twenty years, the initial cost would therefore amount to only 5s. 4d. per year. However, additional wires will need adding, and the position of existing wires altered in certain trees every year. If it is taken that one extra wire is added to each tree each year this extra material and labour would increase the annual cost by about 10s. 8d., making the total annual cost per 100 trees 16s., as compared with £8 when wooden props are used.

Further matters that must be taken into consideration when making a comparison between the two systems of tree supports are the loss of fruit as a result of the use of wooden props. It is far from uncommon for a number of props to be displaced every year, while supporting heavily laden limbs, by strong wind and many other causes. This displacement frequently results in a broken limb. Also limbs not infrequently break off at the point of contact with the prop. To estimate the loss from such limb breakages suppose that one limb on every tenth tree, carrying an average of 1 bushel of fruit, breaks each season. This limb will take about five years to replace, during which time the new branch will yield about 1½ bushels of fruit, compared with five cases if the limb had not broken. At this rate in five years there will be fifty broken limbs in every 100 trees, with an average annual loss of 175 bushels of fruit. Valuing this fruit at 1s. 6d. per bushel the annual loss is £13 2s. 6d.

Sun scald is the cause of considerable loss of apples in many districts. The loss of fruit in this way is in many seasons practically confined to fruits in the centre of trees which are suddenly exposed to the direct rays of the sun as a result of limbs being borne outwards by the weight of fruit. This trouble does not occur in trees that are securely wire-braced. If it is assumed that the annual loss from sun scald is one-sixth of a bushel per tree the loss from 100 trees at 1s. 6d. per bushel would amount fo £1 5s.

There is a tendency with all trees regularly carrying heavy crops for the limbs to gradually become more and more horizontal, even during the dormant season, and it is not uncommon for a considerable number of limbs in most orchards to have to be removed or considerably shortened every pruning season on account of being in the way of cultivation and other orchard work. The loss of limbs in this way would be about as great as that caused by limbs breaking, consequently a further quantity of fruit to the value of £13 2s. 6d. is annually lost fo the grower.

It is common knowledge that the more horizontal a branch becomes the more the growth is retarded, also the more vertical a limb the more vigorous will be the growth. The main limbs of most heavy bearing varieties are invariably prone to assume a more horizontal position each year. This undesirable tendency is either rectified or prevented, as the case may be, where a permanent system of tree support is employed.

There is one, and one only, consideration in favour of the use of wooden props—namely, that with this system of tree support a far greater proportion of the crop can be harvested without the use of ladders. However, this advantage is more than offset by the inconvenience caused by the props interfering with the various orchard operations.

The monetary gain per annum on every hundred trees by the use of the central system of wire-bracing compared with the use of wooden props, may be summarized as follows:—

	£	s.	d.
Difference between cost of props, plus labour, and cost of wiring material, plus labour	7	4	0
Saving of loss through broken limbs	13	2	6
Saving of loss caused by sun scald	1	5	0
Saving of loss through limbs being shortened back	13	2	6
Total saving	34	14	0

UTILIZATION OF NATURAL HEAT RESOURCES IN THERMAL REGIONS.

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The object of this article is to give in brief outline a few of the recent developments in the utilization of subterranean heat, with a view to emphasizing the great possibilities of this source of natural energy. When the world-wide occurrence of thermal activity is taken into account it is surprising to find that, so far as is known to the writers, there are only three localities in the world where any noteworthy interest has been taken in harnessing this latent heat energy; these are Tuscany (Italy), California, and Iceland.

In the last-named country "earth heat" is not regarded as a luxury, but as a necessity, for here volcanic activity has provided abundant areas of heated soil, making possible the cultivation of crops normally grown only in more temperate regions. Moreover, steam from the hot springs is adapted to the heating of homes and to the provision of hot water for both baths and laundries. Recently, despite the disadvantages of an exceptionally cold climate, the enterprising Icelanders have built glasshouses on areas of warm earth, enabling the commercial production of fruit and vegetables which previously had to be imported.

Thermal activity in Tuscany extends over an area of approximately a hundred square miles, in which fumaroles or powerful steam vents are characteristic features. In certain parts of this district the steam, after the small quantities of boric acid which it contains have been extracted, provides power for low-pressure turbines.

During the past ten years, wells have been sunk in "The Geyser" area of the St. Helena Range, near San Francisco, California. Despite the apparently feeble superficial activity compared with that of the thermal area of Tuscany it is of interest to note that half of the small number of wells developed in this area are superior both in pressure and steam output to any yet reported in Italy.

The foregoing remarks are offered merely as an introduction to a most interesting subject. It is now proposed to discuss a little more fully the natural heat resources of the various countries concerned. Reference will also be made to the possibilities of developing the natural heat resources in the thermal districts of this Dominion.

ICELAND.

This island, situated between 63·5° and 66·5° of latitude in the North Atlantic Ocean, covers an area of some 65,000 square miles, consisting mostly of lava plains, glaciers, and other barren features. Broadly speaking, about half the remainder, comprising sandy plains and shingle slopes, is in grass. The soil available for cultivation is fertile, but in consequence of the cold climate (mean temperature, 37° F.) vegetation does not flourish except in the vicinity of hot springs, fumaroles, geysers, and warm pools distributed evenly throughout the country in some sixty-five localities. Such areas of heated ground, often a few acres in extent, do not freeze even in winter, but maintain a temperature of from 50° to 158° F. in the topsoil, permitting and encouraging the growth of native flora.

The historians of early Iceland frequently refer to the use of hot springs for laundrying and for providing hot water for baths. In this connection the record of the historian Sourri Sturlason (A.D. 1300) may be cited. Hot and cold water were led from a warm pool close to his farm in Reykholt to his wash-basins, in order that the temperature might be adjusted.

Despite the early acquaintance with earth heat in Iceland it is only within the last ten years that serious efforts have been concentrated on the scientific development of such a valuable natural asset. Furthermore, it should be quite evident from the description which follows that although the exploitation of thermal heat is still in its infancy, results recently obtained appear to justify fully the expense and trouble involved. It has evidently been quite a customary procedure for the Icelander to cook his food either in hot earth or in hot springs. For example, bread was prepared by placing the dough in tin moulds and then covering it up with hot earth or lowering it into hot springs. The article prepared in this way had the reputation of being very wholesome. The modern tendency, however, is to bring the hot water from the springs by means of leads to specially adapted ovens in the houses. Steam from hot springs is also the basis of the central heating-systems in many schools and farmhouses throughout the country.

About the middle of the nineteenth century a series of experiments led to the successful recovery of salt from sea-water by pumping the latter into shallow pans and evaporating with the aid of hot springs beneath. This procedure has had to be discontinued owing to the difficulties of obtaining a suitable market.

It is perhaps in agriculture that the most useful application of earth heat has been found. A small proportion of the ground in the vicinity of patches of warm water carries grass, and, while little or no attention has been directed to the improvement of these meadow lands, notable progress has been made in the cultivation of various crops such as potatoes, cauliflowers, and cabbages, which are grown extensively in the warm soil areas. In several cases the warm areas have been extended by means of a system of hot-water earthenware pipe-lines under the ground. Such pipes are said to heat the surrounding soil for a distance of about 15 ft.

The results of these and other experiments have been responsible for the erection of glasshouses on specially selected areas of warm

FIG. 1. SHOWING METHOD OF HARNESSING A HOT SPRING IN ICELAND FOR USE OF A SMALL DAIRY-FACTORY.

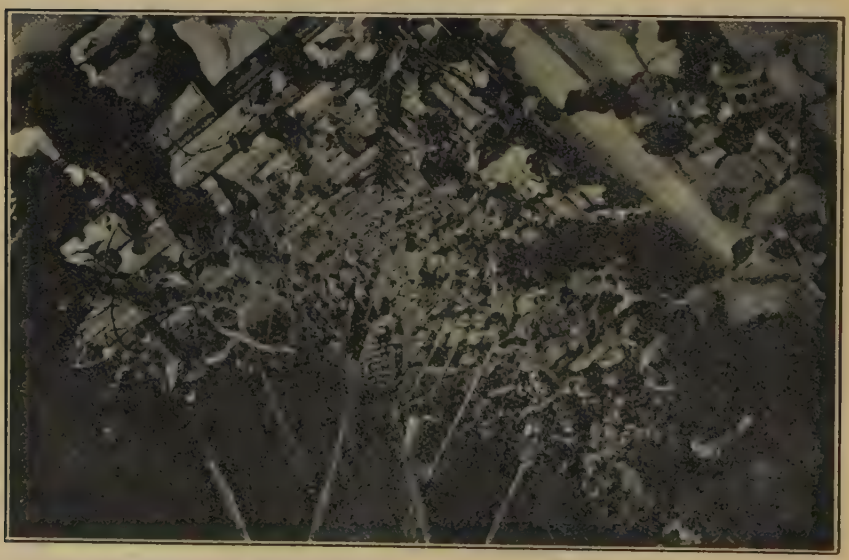

FIG. 2. GLASSHOUSE AT REYKIR, ICELAND, UTILIZING NATURAL HEAT FOR THE GROWING OF MELONS.

[From "Die Ernährung der Pflanze."

soil. Since the installation of the first glasshouse in 1923 several others of a more substantial type have been constructed, and not only has the culture of fruit and vegetables formerly imported from more temperate regions now been rendered possible, but a small export trade in garden products has been developed. It is interesting to note that the following fruits and vegetables have been grown successfully: Cauliflowers, red beet, spinach, mangels, peas, lettuce, onions, tomatoes, cucumbers, melons, pumpkins, grapes, strawberries, mushrooms, and beans. It is also understood that the germination of seeds can be greatly assisted by the means described. The vitamin-rich melons and tomatoes are especially valued by the Icelanders, and it is hoped that the adoption of electric light for the glasshouse crops during the long and dull winter months will still further assist in the growing of the products mentioned.

Firing materials are very expensive in Iceland, but these are no longer required in the thermal locations, as the hot spring water is used for heating and cleaning utensils, for pasteurization of milk, and for warming the sheds and cow-houses. It may also be mentioned that spinning-jennies were at one time operated from hot springs.

It has been brought to our notice that the employment of steam heating for improving the production of crops is not confined solely to Iceland. It appears that in Yorkshire the waste steam and hot water woollen mills are run into reservoirs, and thence from a series of pipe-lines into adjacent fields. By this means the fields are kept at an optimum temperature for the production of rhubarb, which is not only obtainable earlier, but is of better quality than that grown in other parts of the district.

Tuscany.

The thermal area in Tuscany, occupying some hundred square miles of territory on the heavily wooded Catena Metallifera Range, is situated to the south of Pisa and is bordered by the higher valleys of the Cecina and Cornia Rivers. The volcanic manifestations take the shape of powerful steam jets or *soffioni* as they are known locally, which by their erosive action form about their orifices pools of muddy water or *lagoni*. The economic development of these is dependent upon the small amount of boric acid (approximately 1 part per 1,000 of the *lagoni* water) accompanying the steam.*

Towards the end of the eighteenth century attempts were made to recover the boric acid by evaporating the *lagoni* waters with the aid of ordinary fuel. In the year 1827 Larderello, an engineer, greatly improved the method by employing the steam from the *soffioni* to evaporate the boric acid; the product thus obtained, however, was only 82 per cent. pure as compared with the 99 per cent. article now produced. Since 1899, under the skilful guidance of Prince Ginori Conti the work of Larderello has been considerably advanced. The old *soffioni* are now replaced by artificial wells 180 to 600 ft. deep, from which steam is led through steel pipes and

* Dr. Wohlmann records in his book, "Mineral Waters and Spas of New Zealand," that the Hanmer Springs contain 25·1 grains of borax per gallon, and the White Island lake 21 grains of boron trioxide per gallon, or expressed as boric acid 0·060 and 0·32 parts per 1,000 respectively.

washed with uncontaminated water to extract the boric acid. The water for this operation is obtained either by pumping or from the natural steam. After the further extraction of carbon dioxide the steam passes on to low pressure turbines to supply electricity in bulk not only for the needs of local industry, but to Italian cities situated some considerable distance away. The concentration of the extracted boric acid is accomplished in a series of shallow lead evaporating receptacles approximately 150 ft. by 3 ft. in size. These gently sloping pans are so arranged that the boric acid solution flows from one pan to the next against the counter current of steam underneath, and thence into a vat where the liquid cools and the boric acid crystallizes out.

Among the by-products of the boric acid industry are ammonium carbonate formed from the separated and purified ammonia and carbon dioxide, borax obtained from the fusion of boric acid with sodium carbonate, and sodium perborate used for bleaching purposes.

In the light of these remarks it is noteworthy that although the power plant at Larderello is responsible for the refining of the products from the *soffioni* this establishment is only one of eight similar power plants which together constitute the Societa Boracifera di Larderello; further, it is considered by Prince Conti that the areas now worked, constituting but a small part of the whole thermal region, are far from being fully developed.

The *Journal of the Society of Chemistry and Industry* for 3rd July, 1931, gives the estimated output in kilograms (1 kg. = 2·2 lb.) of the principal products manufactured by the Societa Boracifera in 1930 as follows: Boric acid (crude), 590,000; boric acid (pure), 1,100,000; borax, 3,100,000; ammonium carbonate, 275,000; sodium perborate, 30,000; carbon dioxide, 195,000.

California.

The area referred to here occurs as a part of a more extensive thermal region situated round about the rugged St. Helena or Mayacmas Range, commencing from thirty miles north of San Francisco and extending nearly fifty miles parallel to the coast.

Thermal activity is evident on both the eastern and western sides of the range, but on the western side it is the more pronounced. This is interesting in view of recent attempted industrial developments. On the western slopes of the range a hypothetical fault-line connecting the mercury deposits and springs has been traced for twenty-five miles along a creek known as Sulphur Creek, the bed of which is a narrow canyon forming the southern boundary of the St. Helena Range. The most active part of this line is "The Geysers," an old health resort provided with an accommodation-house dating back as far as the year 1852.

The thermal activity of the locality is evidently feeble, as the great majority of natural vents may be described as merely gas seepages, although the ground temperature in parts may be as high as 208° to 210° F. Only three active fumaroles occur, and these are situated on the banks above Geyser Creek. The hot springs are also shallow and quite insignificant as regards size, although the temperature of the issuing water is seldom below 140° F.

The credit of first attempting to exploit the natural steam of this district would appear to belong to J. D. Grant, of Healdsburg, California. Of the four wells sunk between the years 1921 and 1924 on the eastern bank of Geyser Creek by this promoter, the first failed because the steam pressure generated, on closing the well, blew out the casing, and the fourth, sunk on the extreme border of the hot ground, was discontinued at a depth of 154 ft. In the first successfully sunk well, after drilling through some 180 ft. of decomposed rock and piercing a sandstone cap, an 8 in. steel casing was lowered and finally fixed in the rock with molten zinc. Eventually, by continuing the boring as an open hole a depth of 203 ft. was reached, giving a static steam pressure of 62 lb. per square inch. The steam power from this well was used to bore a second well to a depth of 318 ft., providing a static steam pressure of 61 lb. per square inch.

In January, 1925, the work of this pioneer was taken over by the Diamond Drill Contracting Co. of Los Angeles. This company, by reason of its strong financial backing, was able to continue the work on a larger scale, and by June, 1926, five wells ranging in depth from 450 ft. to 650 ft. were put down. There were thus in all seven wells ranging from 200 ft. to 650 ft. in depth, and in static pressure from 60 lb. to 275 lb. per square inch. The principal facts to be learnt from the behaviour of these artificial steam-wells are (1) a steam flow may be developed by boring anywhere within the hot area, (2) the pressure of steam increases with the depth of the boring, (3) boring gives rise to steam-wells which even when close together may exhibit widely different pressures, (4) each well, after a period of discharge, when closed again returns to its original pressure.

It is not known to the writers to what extent the steam from these wells has been utilized, but from all accounts four of the wells established by the company together are estimated to represent a switch-board delivery of 4,500 kilowatts.

Thermal Resources in New Zealand.

The thermal region of New Zealand is usually defined as ranging from the central volcanoes south of Taupo in a northerly and north-easterly direction comprising the Rotorua district, and extending over the Bay of Plenty as far as White Island and Whale Island. The fumaroles generally occur in groups, but in some cases are met with isolated. Among some of the fumaroles may be mentioned the large group at Ketetahi and Tokaanu to the south of Lake Taupo; others occur at Wairakei, Orakeikorako, Waiotapu, Rotorua, Waimangu, and elsewhere. None of these fumaroles, except the Karapiti blowhole near Wairakei, are very powerful, but notwithstanding this a good pressure of steam could no doubt be obtained by boring in suitable spots as in California.

The main hot springs groups are at Tikitere, Whakarewarewa, Ohinemutu, Waimangu, Waiotapu, Orakeikorako, Wairakei, Rotakawa, Taupo, and Tokaanu, although hot springs are to be found in widely scattered locations in both the North and South Islands. At Ohinemutu, Ohaki, and Tokaanu the springs are all alkaline; the remaining groups are acid, or partly acid and partly alkaline. There is little doubt also that the thermally altered ground round the alkaline group of springs is acid. It is in this particular direction that difficulties would be

encountered if any attempts were made to utilize natural heat resources, for the acidity of the water in some of the hot springs has a corroding effect on iron or steel pipes, necessitating the use of glazed earthenware pipes; moreover, the soil in immediate proximity to springs, being of an acidic nature, would require special treatment before being adapted for horticultural purposes. Nevertheless it would appear that difficulties encountered in the form of acid springs, &c., have been overcome in the countries already mentioned.

The Maori inhabitants of our thermal region have long known how to take advantage of the exceptional natural facilities, with the result that Native villages are to be seen close to conveniently situated hot springs, and it is still customary for the Natives to bathe and wash clothes in hot pools, and to cook food placed in flax baskets which are lowered into suitable steam vents.

According to Dr. Herbert, in "The Hot Springs of New Zealand" (1921), the Sanatorium gardens at Rotorua were set out by taking soil and placing it in a wilderness of sulphur beds and pumice. As the subsoil is warm these gardens constitute an ideal forcing ground for flowers, which bloom in profusion. It would seem that properly controlled warming of the ground by means of pipes from hot springs or the making of hotbeds in suitably chosen areas would remove the dangers of the hard frosts which are common at Rotorua in winter, thereby assisting in the early or out-of-season production of certain hothouse and other horticultural crops under the influence of the sunny climate. In many parts of the district the soil is of good texture and is remarkably responsive to phosphatic fertilizers in particular.

It may be mentioned in passing that at one time the gas from the Hanmer Springs (South Island), consisting chiefly of methane, was collected and utilized for lighting and cooking purposes at the sanatorium there.

It appears that the hot spring localities in Iceland have already been carefully surveyed and mapped, and a similar complete compilation and correlation of recorded data of the characteristics and locations of all the hot springs in New Zealand would be of considerable assistance in deciding the possibilities of exploitation of these natural resources from the industrial and agricultural standpoint. A close study of the mineral content of the local thermal springs might possibly indicate the position in regard to the profitable recovery of certain chemical substances by evaporation with the abundant natural heat. In particular the expensive iodine salts, which are held to be present in relatively large quantities in a number of hot springs—Morere and Te Puia Springs, for example—might possibly be utilized for pharmaceutical purposes and for iodized licks for farm animals. Some of the other salts present (notably common salt in abundance) might also in the future be recovered and appropriately used. Some of the gases accompanying fumarole steam have commercial importance—for instance, carbon dioxide, the chief gaseous constituent of the volcanic steam of many thermal regions has been successfully recovered in Tuscany.

In conclusion, it may be pointed out that the thermal region of New Zealand compares favourably with that of Iceland in several respects, including extent, power, adaptability, and suitability of soil and climate for agricultural utilization.

THE COOL STORAGE OF ONIONS.

R. SUTHERLAND, Cool Storage Officer, Department of Agriculture.

ALTHOUGH it is well known that onions can be kept for a lengthy period in common storage, it is also known that, as with most other perishable products, they tend to decompose if not protected by refrigeration. The conditions most favourable for this decomposition are heat and moisture; therefore the prompt removal of heat and the proper control of humidity ensure an efficient safeguard against deterioration.

The three elements which influence the life of onions in cool storage are temperature, humidity, and ventilation. Experiments have been carried out from time to time in order to determine how these elements should be combined to provide the most favourable storage conditions for the preservation of onions, and while it is well known that the varieties which keep best in common storage will remain in good condition for a longer period in cool storage, it is recognized that it may not be desirable in commercial practice to follow out certain methods with all varieties when grown under varying soil and climatic conditions.

Prestorage factors: Growers of onions who have been storing their product in common storage are fully aware of the fact that, like all other perishable commodities, apart from variety characteristics, maturity at the time of gathering, the nature of handling, cleaning, and drying are most important factors which have considerable influence on the storage life of this vegetable, both in common or cool storage. If onions are damaged during harvesting, packing, or handling, and not be thoroughly dry, they will very soon commence to decay.

Stowage: Only the good keeping varieties should be placed in cool storage, and the onions should be packed in bags or crates made of wood and stacked in the compartment in such a way as to allow the cold air to circulate round them. If stowed in bags, shelves should be provided in order to prevent bruising by the weight of the onions in the top bags pressing on the lower ones.

Onions must be stored in a separate compartment: While any of the several systems of refrigeration in general use may be suitable for the cooling of onions, providing adequate provision is made for circulation of the cold air and for ventilation, it should be borne in mind that a refrigerating system cooling a room in which this vegetable is stored must not be common to a compartment containing another commodity, otherwise the goods may become tainted by the gas given off by the onions and thereby spoiled.

A LOCAL INVESTIGATION.

During the present year a trial on a commercial scale was carried out with 80 tons of onions of the Straw Spanish variety. These were grown at Pukekohe, packed in ordinary onion bags, and forwarded by rail to cool storage at Wellington. The first consignment came to hand on 13th February and the last on 2nd March. As each lot came forward the onions were immediately placed in the cool compartment which had been specially prepared for them. The cold storage company undertook its part not only in this regard but also

in connection with the maintenance of uniform conditions during storage. It was evident that the growers had exercised every care in the harvesting, drying, and packing of their crop for storage, as, with the exception of a number of double onions, which should have been rejected, all were in sound condition.

Fitting of the Compartment for Stowage.—The storage compartment was fitted with a system of shelves the length of the room. These were made of hardwood battens in the form of a grid, spaced in such a manner as not to interfere with the circulation of cold air through and between the containers. The distance between the shelves was just sufficient to take the bags filled with onions, standing on end, so that the onions in each individual bag would have only to support their own weight on the platform, and not be subject to that of a number of other bags. This eliminated the danger of faulty stowage and bruising of the product, to which a large amount of wastage is often due.

System of Cooling.—The storage compartment, which was cooled by the brine pipe or grid system, was fitted with trunks and a fan for circulating the cold air, and with special openings for ventilating the room by drawing in fresh air through one channel and discharging the gas given off by the onions through another channel into the external atmosphere.

Temperatures.—The storage-room and the insulation were cooled before loading commenced, and a temperature of 31° F. maintained as uniformly as possible during loading and throughout the storage period. The only variation occurred during ventilation, when the temperature rose to 32°–33° F. As the storage temperatures for onions vary slightly according to variety characteristic, and cultural and climatic factors, this variation in temperature was too small to require much consideration.

Ventilation and Humidity.—The accumulation of gas given off by the onions was prevented by ventilating the room daily by the process referred to above, care being taken not to allow the temperature or relative humidity to rise unduly during the period the ventilating shutters were open to the atmosphere. This minimized the danger of sprouting which is likely to occur, particularly in the early spring, should the temperatures or moisture content of the atmosphere in the compartment rise above normal for any length of time. During the first four weeks the relative humidity in the storage-room was 81 per cent., after which it was reduced to 78 per cent., and held as steady as possible during the storage period.

Results.—Inspections were carried out at frequent intervals, and the onions were in good condition after storage for between six and seven months. Although it is quite possible that the onions would have stored successfully for a further period, they were discharged and sold at a price which should leave the producer a good profit after allowing for all handling, transport, and cool storage charges. Specimens removed from storage at intervals remained sound and were comparable in every way to the newly gathered product.

By the production of the more hardy varieties of onions and the utilization of available cool storage facilities, the ability to supply our local markets throughout the greater part of the year may be anticipated.

WHEAT VARIETY TRIALS IN THE SOUTH ISLAND, SEASON 1931-32.

Fields Division, Department of Agriculture.

FOURTEEN trials to determine the relative yielding-capacities of certain wheat varieties or selected lines of crossbred wheats were laid down in Canterbury, Otago, and Southland during the 1931–32 season in collaboration with the Wheat Research Institute.

The *Journal* for June, 1931, contained a summary of three years' wheat variety trials conducted up to and including season 1930–31, and although in these trials Solid-straw Tuscan had definitely proved its superiority in most districts it was decided to carry out further trials with varieties in selected districts where the superiority of Solid-straw Tuscan had not been definitely established. In three trials lines of a cross between Solid-straw Tuscan and White Fife, supplied by the Wheat Research Institute, were tested against Solid-straw Tuscan and one or two other varieties. Some lines of this cross gave promise of having milling and baking qualities superior to those of Solid-straw Tuscan, and preliminary trials indicated that certain lines gave yields as good as that of the Tuscan under certain conditions. Samples of all varieties were forwarded to the Wheat Research Institute after harvesting for milling and baking tests.

For purposes of this report the trials here described are divided into three classes—namely, "Standard" variety trials, in which the most commonly used wheats were compared; "Quality" variety trials, in which high-quality wheats such as Garnet or Marquis are included; and "Crossbred" trials, in which lines of Cross 7 (Solid-straw Tuscan × White Fife), referred to above, are compared with Solid-straw Tuscan and one or two other varieties.

For layout of the trials, rate of seeding, manuring, and statistical examination of results, reference should be made to this *Journal* for June, 1931, pages 398 and 399.

Harvesting: Owing to extremely dry conditions prior to the 1932 harvest three of the fourteen trials could not be harvested, and in a few other cases the straw was only just of sufficient length for harvesting to be carried out. Wherever possible each variety was cut when ripe, but labour facilities did not always allow of this being done, and in some cases varieties had to stand for some days after ripening at the risk of being shaken. In one or two trials the grain was badly sprouted and discoloured as a result of wet and humid conditions when the wheat was in stook.

"STANDARD" VARIETY TRIALS.

Seven of these trials were sown, but only five were carried to completion. Details of the latter follow, and the yields are summarized in Table 1.

(1) *Trial No. 16/3/7: F. G. Horrell, Horrelville, North Canterbury.*

Date sown, 5/5/31. Major cut 12/1/32, Dreadnought cut 14/1/32, Solid-straw Tuscan, Solid-straw Velvet, Yeoman, and Victor cut 23/1/32. The crop was affected with "take-all," causing a number of plants to

Table 1—Yields of Varieties in "Standard" Class Trials, 1931–32.*

Variety.	(1) F. G. Horrell, Horrelville.		(2) High School, Rangiora.		(3) A. Grant, Waimate.		(4) G. Stevenson, Weston.		(5) J. Newlands, Ngapara.		Lincoln College.†
	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Velvet.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan ..	40·7	..	60·7	..	47·5	..	27·5	..	‡	..	..
Major§	51·7	**+11·0**	65·1	**+4·4**	54·5	**+7·0**	..	..	..	..	**−19·9**
Solid-straw Velvet§ ..	35·4	**−5·3**	59·0	−1·7	..	..	..	..	..	..	+1·7
Yeoman	36·6	**−4·1**	50·6	**−10·1**	51·9	**+4·4**	43·5	**+16·0**	..	..	**−17·0**
Victor	42·8	+2·1	61·2	+0·5	..	..	..	..	..	..	**−13·6**
Dreadnought ..	56·4	**+15·7**	..	..	56·2	**+8·7**	41·8	**+14·3**	..	..	**+4·4**
College Hunter's II ..	..	..	57·1	**−3·6**	51·7	**+4·2**	..	..	..	..	**−17·5**
Velvet 18/27 ..	..	..	..	..	57·7	**+10·2**	..	..	14·4	−0·7	..
Velvet	..	..	..	..	..	..	..	..	15·1	..	**−11·6**
Dreadnought 5/27 ..	..	..	..	..	..	..	42·0	**+14·5**	..	..	**+5·5**

* See Table 2 for a trial including Victor. † Figures taken from report of Wheat Research Institute for quarter ending 31/5/32. As these are the results of two trials, differences only from Solid-straw Tuscan are given. The average yields of Tuscan in these trials was 62·2 and 67·1 bushels per acre respectively. Major was badly damaged by birds. ‡ Solid-straw Tuscan was not used in this experiment. § See Table 3 for two other trials including these varieties.

NOTE.—In this and the following tables differences preceded by a plus sign denote an increase over Solid-straw Tuscan; a minus sign denotes a decrease. Increases or decreases printed in heavy type are statistically significant.

lodge. The binder, however, was able to pick up most of the heads. A little shaking occurred with Yeoman and Victor during cutting. Many heads of Solid-straw Velvet were lost when carting the sheaves for threshing.

(2) *Trial No. 16/3/429 : High School, Rangiora, North Canterbury.*

Date sown, 22/6/31. Major cut 12/1/32, Solid-straw Tuscan, Victor, College Hunter's II, Yeoman, and Solid-straw Velvet cut 22/1/32. When cut Hunter's had the tallest growth, overtopping the other varieties by 4 in. to 5 in. Yeoman and Victor were an inch or two below the growth of Tuscan, which was about equal to Major and Solid-straw Velvet. Solid-straw Tuscan and Solid-straw Velvet were the ripest when cut, Hunter's not quite so ripe, while Yeoman and Victor were the least ripe of the varieties.

(3) *Trial No. 16/3/494 : A. Grant, Waimate, South Canterbury.*

Date sown, 18/6/31. Major cut 29/1/32, Solid-straw Tuscan, College Hunter's II, Dreadnought, Velvet 18/27, and Yeoman cut 2/2/32. The crop was fed off, and on 7/10/31 considerable differences in the varieties as a result of the feeding-off were apparent. Tuscan had been eaten bare, while Major had also been well sought after ; Velvet had been more or less neglected by stock. On 29/1/32 Tuscan, which looked the poorest, had developed stem-rust badly ; the other varieties were also attacked, but to a lesser extent. On 2/2/32 it was observed that Hessian fly had attacked Dreadnought badly, and the other varieties, except Tuscan, had also been slightly attacked. At threshing all varieties were badly sprouted except Tuscan, which yielded quite a good sample of grain. Hunter's was in the worst condition and was not really fit to thresh.

(4) *Trial No. 16/4/286 : G. Stevenson, Weston, North Otago.*

Date sown, 27/5/31. All varieties—Solid-straw Tuscan, Dreadnought, Dreadnought 5/27, and Yeoman—cut 13/2/32. At cutting all varieties were at about the same stage of maturity. The crop was fed off during September. Tuscan was grazed hard ; other varieties were fairly well grazed except Dreadnought 5/27, which was hardly touched by stock.

(5) *Trial No. 16/4/222B : J. Newlands, Ngapara, North Otago.*

Date sown, 3/6/31. Local Velvet and Velvet 18/27 both cut 26/2/32. There was not a great deal of difference in the appearance of the two strains ; both were fairly light and had shaken rather badly.

"Quality Variety" Trials.

Four trials, in which one or more of the high-quality wheats were included, were laid down, but only three were harvested. Details of these follow, and the yields are summarized in Table 2.

(6) *Trial No. 16/3/505 : S. Lemon, Lyndhurst, South Canterbury.*

Date sown, 23/9/31. Garnet cut 25/1/32, Reward cut 27/1/32, Marquis cut 6/2/32, Solid-straw Tuscan and White Fife cut 10/2/32. On 25/1/32 Garnet was slightly riper than Reward ; a certain amount of shedding of grain took place ; Marquis was still quite green. On 27/1/32 Reward was cut with the binder, when a heavy loss of grain

occurred owing to shaking under the action of the packers and the shortness of the crop. On 26/2/32 Marquis lost grain from a north-wester just before cutting, and a fair proportion over the binder. On 10/2/32 White Fife was not as ripe as the remainder. This variety was especially attacked by wire-worm. Being the tallest-growing of the varieties, it made the best sheaves with the least loss of grain. There was a fair loss with the Tuscan owing to its short growth.

(7) *Trial No. 16/4/303: C. Milne, Milton, South Otago.*

Date sown, 17/9/31. Marquis and Major cut 29/2/32, Solid-straw Tuscan and Solid-straw Velvet cut 11/3/32. On 29/2/32 Marquis was dead ripe, and the nodes of Major were still greenish in colour. Losses of grain occurred when cutting Major and Marquis. On 11/3/32 the Tuscan was dead ripe, whereas the Velvet was still green at the nodes. On 6/4/32, at threshing, samples of grain were on the damp side, and of the four varieties Tuscan seemed to be the driest. Solid-straw Velvet was the only variety to develop stem-rust.

(8) *Trial No. 16/4/314: Experimental Area, Gore, Southland.*

Date sown, 6/10/31. Garnet cut 7/3/32, Marquis cut 15/3/32, Major, Solid-straw Velvet, and Solid-straw Tuscan cut 1/4/32. Garnet, Marquis, and Major were all ripe when cut. The Velvet and Tuscan would have required another fortnight before being properly fit, but, owing to foggy weather causing discoloration of grain and bad infection of stem-rust, these varieties were cut at the same time as Major. All varieties were badly damaged by birds just prior to harvesting and while in stook. Garnet suffered more from bird damage than did the other varieties, on account of earlier ripening and the fact that it was longer in stook.

Table 2.—Yields of Varieties in "Quality Variety" Class Trials, 1931–32.

Variety.	(6) S. Lemon, Lyndhurst.		(7) C. Milne, Milton.		(8) Experimental Area, Gore.	
	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan	31·9	..	59·4	*	53·2	*
Marquis† ..	16·4	‡	58·2	−1·2	47·4	−5·8
Garnet ..	23·9	**−8·0**	..	..	24·9	−28·3
Reward ..	15·3	‡	..	..	..	..
White Fife ..	22·7	**−9·2**	..	..	..	..
Major	..	..	51·9	−7·5	47·2	−6·0
Solid-straw Velvet	..	..	58·7	−0·7	42·9	−10·3

* Yields not treated statistically. † See Table 3 for a further trial including Marquis.
‡ Not comparable with Solid-straw Tuscan. Garnet was significantly better than Marquis to the extent of 7·5 bushels per acre. Reward was significantly lower in yield than Marquis by 1·1 bushels per acre.

"Crossbred" Trials.

Three of these trials were laid down and harvested. Details are given below, while the yields are summarized in Table 3. Various lines of the cross—White Fife × Solid-straw Tuscan—are indicated by numbers—for example, 7·05.

(9) *Trial No. 16/3/498: D. Mulholland, Darfield, Canterbury.*

Date sown, 5/6/31. All varieties cut 20/1/32. Varieties, Solid-straw Tuscan and Victor. Crosses, 7·01, 7·02, 7·04. On 20/1/32 Victor had the least growth of the varieties; Solid-straw Tuscan had the most growth, being about 1 in. taller than the crosses. Tuscan ripened with a perpendicular head, whereas the crosses had a drooping head and had developed more out of the shot blade than had the Tuscan. This trial suffered from the extremely dry pre-harvest conditions.

(10) *Trial No. 16/3/426: J. Ruddenklau, Methven, Canterbury.*

Date sown, 1/6/31. All plots cut 1/2/32. Varieties, Solid-straw Tuscan and Marquis. Cross, 7·05. On 1/2/32 Marquis was dead ripe, Tuscan was just right for cutting, but Cross 7·05 was a shade greener. Marquis had shed some grain and the sheaves were very light. Both Tuscan and Cross 7·05 had much stem-rust; Marquis had very little in comparison.

(11) *Trial No. 16/3/428: A. Amos, Wakanui, Canterbury.*

Date sown, 5/6/31. All plots cut 20/1/32. Variety, Solid-straw Tuscan. Crosses, 7·06, 7·08, 7·09. On 20/1/32 all varieties were ripe and none had shaken. A little stem-rust was showing throughout. The straw was fairly short.

Table 3.—Yields of Varieties in "Crossbred" Trials, 1931–32.

Variety.	(9) D. Mulholland, Darfield.		(10) J. Ruddenklau, Methven.		(11) A. Amos, Wakanui.		Lincoln College.*	
	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan ..	23·7	..	45·2	..	49·7	..	†	..
Cross 7·01 ..	18·8	**−4·9**	..	..	..	..	56·1	**−15·2**
Cross 7·02 ..	24·4	+0·7	..	..	..	..	70·1	+2·0
Cross 7·03 ..	..	..	..	..	..	..	70·7	+1·1
Cross 7·04 ..	24·5	+0·8	..	..	..	..	70·0	−3·5
Cross 7·05 ..	..	..	43·9	−1·3	..	..	67·3	**−7·0**
Cross 7·06 ..	..	..	..	..	44·7	**−5·0**	70·4	−3·9
Cross 7·07 ..	..	..	..	..	..	..	66·3	**−7·6**
Cross 7·08 ..	..	..	..	..	43·1	**−6·6**	60·4	**−13·2**
Cross 7·09 ..	..	..	..	..	46·9	**−2·8**	68·5	**−5·1**
Marquis	..	..	34·6	**−10·6**	..	..	..	..
Victor	17·9	**−5·8**	..	..	..	..	..	..

* Results taken from report of Wheat Research Institute. † The average yield of all Solid-straw Tuscan plots was 72·5 bushels per acre.

Trials laid down but not harvested.

Trial No. 16/3/503: E. A. Woodfield, Horrelville, North Canterbury.

Solid-straw Tuscan, Garnet, Reward, Marquis, and White Fife were sown in this experiment on 7/9/31. Owing to the extremely poor growth after dry conditions, and the shortness of the crop, the plots were not harvested separately. The Tuscan, although very poor, was the best variety and was the only one which formed grain to any extent. Garnet was possibly the next best, and had more growth than the remaining varieties.

Trial No. 16/3/490: J. Armstrong, Claremont, Canterbury.

The varieties in this trial—Solid-straw Tuscan, Major, Dreadnought, Yeoman, Victor, and College Hunter's II—were sown on 27/5/31. On 28/1/32 Major was cut; Hunter's had shaken slightly during a heavy gale, but was not yet fit for harvesting. On 3/2/32 Dreadnought was cut, as it had commenced to shake, although the grain was soft. On 5/2/32 the remaining varieties were harvested; Yeoman was slightly on the green side. As a result of heavy rains and humid conditions when in stook the crop germinated badly, and was not fit for threshing. The experiment was therefore abandoned.

Trial No. 16/4/222A: J. Newlands, Ngapara, North Otago.

This trial, which was sown on 2/6/31, included Solid-straw Tuscan, Major, Hunter's, Dreadnought, and Velvet 18/27. On account of the poor growth as a result of dry conditions, it was decided not to attempt yield determinations, and the trial was abandoned.

Trial by Wheat Research Institute.

In addition to the foregoing a trial conducted by the Wheat Research Institute at Lincoln, in which many of the "quality" wheats were included, was affected by the drought. The varieties in this experiment were Solid-straw Tuscan, Marquis, Reward, Garnet, and White Fife, while the Kansas varieties Oro, Tenmarg, and Kanred × Marquis, were also included. Two sowings of these, on 15/5/31 and 10/9/31 respectively, were made. It is reported that all through the growing season it was apparent that the Tuscan and Garnet sown in autumn would be the only varieties to give any crop at all. The other varieties, owing to the effect of drought being particularly severe on the class of land on which the experiment was sown, ultimately produced ears of about ½ in. in length without any grains at all.

General Remarks.

The results of three trials carried out by the Wheat Research Institute at Lincoln College are included in the tables at the request of the Director of the Institute.

In view of the influence of season and soil on the performance of varieties it is considered advisable to withhold comments on this year's results, but to consider the merits of varieties over the whole of the seasons during which they have been tried as soon as the present season's work is completed. Most of the varieties, with the exception of the "quality" wheats, are again under trial in parts of Canterbury and North Otago. Some of the "quality" wheats will be tried again in South Otago.

The thanks of the Department are extended to those farmers who provided facilities for carrying out these trials. The field work in Canterbury and Otago was under the supervision of Mr. R. McGillivray, Fields Superintendent, Christchurch, and Mr. R. B. Tennent, Fields Superintendent, Dunedin, respectively. The trials were conducted in their respective districts by Messrs. G. G. Calder, W. Stafford, T. Sellwood, E. M. Bates, A. A. Hume, and A. Stuart, Instructors in Agriculture, and at Gore Experimental Area by Mr. W. Sleeman, Overseer.

—A. W. Hudson, Crop Experimentalist, Plant Research Station, Palmerston North, and J. W. Woodcock, Assistant Crop Experimentalist.

SEED CERTIFICATION.

SUMMARY OF OPERATIONS FOR SEASON 1931–32.

Reported by J. H. CLARIDGE, Assistant in Agronomy, Department of Agriculture.

OPERATIONS in connection with seed certification were again undertaken by officers of the Fields Division during the 1931–32 season. The scheme was extended to include the certification of cocksfoot, Montgomery Late Red clover, and Kentish Wild White clover. Changes in the scheme included the introduction of a system of charges (particulars of which were published in the *Journal* for September, 1931) and the alteration of the certification of white clover from an age basis to one of type.

Perennial Rye-grass.

There was again a considerable increase in the perennial rye-grass seed certified. The quantity of seed sealed during each of the last three seasons' operations is as follows: 1929–30, 17,052 bushels; 1930–31, 45,983 bushels; 1931–32, 81,186 bushels. Nevertheless, the price of certified rye-grass seed is still high, and the demand is greater than the supply. There is, however, a rapidly increasing supply of seed becoming available in the South Island. Already a keen demand for certified seed is being exhibited by Australian merchants; while inquiries have also been received from other countries. It is certain that the amount of certified rye-grass seed produced can be considerably increased without danger of overproduction.

It is encouraging to note that seed twice grown in Canterbury from certified mother seed is still maintaining its true perennial characteristics. In this connection it was decided at the commencement

Table 1.—Perennial Rye-grass Field Inspection Results, Season 1931–32.

(Figures in parentheses refer to the 1930–31 season; this applies to all tables in which such figures occur.)

Field Superintendent's District.	Mother Areas.		Permanent Pasture Areas.						Total Areas passed.		Areas rejected.	
			Mother.*		Permanent Pasture only.		First Harvest.					
	Number.	Acres.	Number.	Acres.	Number.	Acres.	Number.	Acres.	Number.	Acres.	Number.	Acres.
Auckland ..	1	10	..	..	..	..	2	6	3	16	..	..
Palmerston N.	214	2,322	365	4,005	79	867	84	689	742	7,883	27	251
	(90)	(1,066)	(276)	(3,302)	(27)	(237)	(35)	(356)	(428)	(4,961)	(84)	(758)
Christchurch ..	..	..	1	15	15	220	47	625	63	860	5	50
							(26)	(344)	(26)	(344)	(3)	(13)
Dunedin ..	..	..	..	..	10	119	50	505	60	624	3	25
					(1)	(34)	(19)	(416)	(20)	(450)	(1)	(13)
Total	215	2,332	366	4,020	104	1,206	183	1,825	868	9,383	35	326
	(90)	(1,066)	(276)	(3,302)	(28)	(271)	(80)	(1,116)	(474)	(5,755)	(88)	(784)

* The produce of these "Permanent Pasture" areas is subject to reclassification as "Mother Seed," provided the sample trial report indicates a sufficiently high standard.

Table 2.—Perennial Rye-grass Acreage Harvested and Sacks sealed in the Field, Season 1931–32.

Field Superintendent's District.	Mother Areas.		Permanent Pasture Areas.						Total.	
			Mother.*		Permanent Pasture only.		First Harvest.			
	Acres.	Sacks.	Acres.	Sacks.	Acres.	Sacks.	Acres.	Sacks.	Acres.	Sacks.
Auckland ..	10	16	..	..	..	..	6	37	16	53
Palmerston North	2,129	4,333	3,467	7,255	784	1,725	657	3,406	7,037	16,719
	(916)	(2,326)	(3,075)	(7,074)	(219)	(726)	(337)	(1,927)	(4,547)	(12,053)
Christchurch ..	..	..	15	41	203	549	556	1,974	774	2,564
							(313)	(1,635)	(313)	(1,635)
Dunedin ..	..	..	..	..	83	179	473	2,590	556	2,769
					(34)	(128)	(396)	(1,771)	(430)	(1,899)
Total ..	2,139	4,349	3,482	7,296	1,070	2,453	1,692	8,007	8,383	22,105
	(916)	(2,326)	(3,075)	(7,074)	(253)	(854)	(1,046)	(5,333)	(5,290)	(15,587)

* See footnote to Table 1.

Table 3.—Perennial Rye-grass Machine-dressing Returns, Season 1931–32.

Class of Seed.	Into Machines.		Out of Machines.	Loss per Cent. during Dressing.	Yield in Bushels per Acre of Machine-dressed Seed.
	Sacks.	Bushels.	Bushels.		
Mother Seed—					
Auckland	11	44	41	7·0	6·0
Palmerston North ..	4,080	26,062	17,043	34·7	8·5
Total	4,091	26,106	17,084	34·6	8·5
	(1,799)	(11,170)	(6,304)	(43·6)	(9·0)
Permanent Pasture (Mother) Seed—*					
Palmerston North ..	6,211	39,884	25,696	35·6	8·7
Christchurch	41	187	137	26·7	9·1
Total	6,252	40,071	25,833	35·4	8·7
	(4,691)	(29,743)	(18,360)	(38·3)	(9·6)
Permanent Pasture Seed—					
Palmerston North ..	1,623	10,220	5,258	48·6	7·1
Christchurch	517	3,021	2,573	14·6	13·4
Dunedin	169	799	470	41·2	6·3
Total	2,309	14,040	8,301	40·9	8·2
	(797)	(4,884)	(3,124)	(36·3)	(13·2)
Permanent Pasture (First Harvest) Seed—					
Auckland	37	109	47	56·9	7·8
Palmerston North ..	3,069	18,440	13,205	38·5	22·3
Christchurch	1,765	9,976	7,888	20·9	15·8
Dunedin	2,055	11,286	8,828	21·7	23·5
Total	6,926	39,711	29,968	24·4	20·6
	(5,206)	(28,019)	(18,194)	(35·2)	(17·8)
Grand total ..	19,578	119,928	81,186	32·3	10·9
	(12,493)	(73,815)	(45,982)	(37·7)	(11·9)

* See footnote to Table 1.

of the season to delete first harvest seed as a separate class, and to include it under the head of Permanent Pasture. The words "First Harvest Seed," however, are stamped across the tags and insert slips to differentiate it from other permanent pasture seed.

Tables 1, 2, and 3 give a summary of the results of the 1931–32 season's activities, making comparisons with the work of the previous season. In connection with the seed certified as "Permanent Pasture, eligible for reclassification as mother seed after sample trial," 90 per cent. of this seed has already been reclassified as "Mother," while about 9 per cent. has failed to come up to the necessary standard. A few lines are still under trial.

Cocksfoot.

Previous to the 1931–32 season numerous samples of cocksfoot seed grown on Banks Peninsula were tested out at the Plant Research Station. All of these samples proved to be typical of the New Zealand strain, so that when the certification of cocksfoot seed was introduced it was possible to treat the whole of the Peninsula district as suitable for the production of mother seed. As a result, practically all the seed from the Peninsula in the season under review was sealed up and certified as New Zealand "Mother Seed" cocksfoot.

The work of paddock sealing and branding on the Peninsula is carried out by inspectors of the Akaroa Cocksfoot-growers' Association, the latter acting under the guidance and supervision of the Department of Agriculture. In addition to this district, samples from a few areas in Mid-Canterbury and Otago had been submitted for trial, and were found to be of the desired type. Two of these areas were entered for certification, and, both being old pastures, were certified as mother seed areas.

The following table gives the number of areas and the acreage entered, the amount of seed harvested, and the quantity of seed finally tagged and certified as mother seed.

Table 4.—Cocksfoot Certification, Season 1931–32.

Item.	Akaroa.	Mid-Canterbury.	Otago.	Total.
Areas entered	129	1	1	131
Acreage entered	4,167	52	7	4,226
Sacks harvested	4,993	82	9	5,084
Sacks into dressing-machines ..	2,605	82	..	2,687
Bushels into dressing-machines	10,339	259	..	10,598
Bushels of machine-dressed seed	8,428	158	..	8,586
Percentage of loss in dressing..	18·5	39·0	..	19·0

White Clover.

As a result of the change in the scheme of certification of white clover, coupled with the general poor yield of white clover seed in the Dominion in the 1931–32 season, very little seed was certified.

Eight lines of certified white clover seed were obtained from the dressings of certified rye-grass in Hawke's Bay. After machine-dressing this gave 692 lb. of mother seed and 1,219 lb. of permanent pasture

seed. In addition, two areas in North Canterbury were entered specifically for white clover production, and from these 631 lb. of mother seed and 3,589 lb. of permanent pasture seed were sealed up and tagged. This gives a production of 1,323 lb. of mother seed and 4,808 lb. of permanent pasture seed, a total of 6,131 lb. certified for the season. It is expected that with more areas eligible for certification, the 1932–33 season will show a marked increase in the quantity of seed certified.

One area of Kentish Wild White clover sown with imported seed was entered for certification last season, but owing to the dry conditions it was later withdrawn.

Brown-top.

There was a remarkable increase in the amount of brown-top certified in Otago in the 1931–32 season, though in other districts a reduction took place. In South Canterbury, where in 1930–31 over 29,000 lb. of seed was sealed and tagged, in 1931–32, due to the exceptionally dry conditions, not one area was entered for certification.

Of the new areas entered which were subject to field inspection all were reported on as being free from red-top and eligible to

Table 5.—Brown-top Certification, Season 1931–32.

District.	Passed.		Harvested.	
	Number of Areas.	Acreage.	Number of Areas.	Acreage.
Mid-Canterbury ..	7	1,700	5	1,350
	(11)	(2,090)	(11)	(2,090)
Central Otago ..	1	300	1	300
Otago	85	11,968	82	11,703
	(70)	(9,533)	(44)	(6,280)
Southland	37	4,329	31	3,059
	(77)	(7,769)	(55)	(5,734)
Total	130	18,297	119	16,412
	(183)	(24,901)	(132)	(19,513)

Table 6.—Brown-top Harvested and Machine-dressed, Season 1931–32.

District.	Number of Sacks Harvested.	Into Machine-dresser.		Pounds of Machine-dressed Seed.	Percentage of Loss in Dressing.
		Sacks.	Lb.		
Mid-Canterbury ..	544	544	37,196	19,034	48·8
	(1,062)	(1,048)	(79,655)	(45,103)	(43·3)
Central Otago ..	31	31	3,046	2,286	25·2
Otago	2,284	2,126	216,479	139,556	35·5
	(828)	(812)	(64,926)	(49,109)	(24·3)
Southland ..	888	752	67,669	37,467	44·7
	(736)	(714)	(66,280)	(47,411)	(26·8)
Total ..	3,747	3,453	324,390	198,343	39·0
	(3,207)	(3,127)	(253,106)	(171,083)	(32·4)

produce certified seed. Tables 5 and 6 give the results of the season's operations. There is likely to be a little more seed machine-dressed, but the quantity will not materially affect the figures.

Red Clover.

Three areas of Montgomery Late Red clover (sown with imported seed) were entered for certification. One area was withdrawn, but the other two passed inspection, and the produce, amounting to 2,057 lb. of machine-dressed seed, was certified to as "New-Zealand-grown Montgomery Late Red clover."

(To be concluded next month with Seed Wheat, Potatoes, and Beans.)

WAIMATE WEST DEMONSTRATION FARM.

SOME NOTES ON THE 1931–32 SEASON.

J. M. SMITH, Instructor in Agriculture, Fields Division, New Plymouth.

THE season of 1931–32 from a weather point of view was one of the most trying that had been experienced in South Taranaki for some considerable time. A cold backward spring was followed by a very dry summer and autumn, and this condition lasted until it was too late for the rain to do very much good, on account of the cold nights.

The season, however, proved how sound was the policy of having a standby provision of hay and silage. Feeding of silage was started at the Demonstration Farm in March, two to three months earlier than usual, and the fodder conserved as hay and ensilage was such that it afforded six months feeding. This depleted the fodder reserves, but, given normal conditions, the current season should see the reserves largely built up again.

The intensive rotational grazing and nitrogen top-dressing trial, where eight 3-acre paddocks are under trial, was again carried on. Observations over the past three seasons indicate that with a herd of sixty cows these paddocks are too small. The value of nitrogen in relation to early feed was again demonstrated, although the cold backward spring retarded all pasture growth, even where nitrogen had been used. From an economic aspect, however, the value of nitrogen as an early feed producer has yet to be determined.

The lucerne stand proved a great standby during the summer and autumn. Usually the second cut is conserved either as silage or hay, but this cut was required for feeding out green in the season under review. The third cut was utilized in a like manner. A gradual invasion of grass has been taking place over the older portion of the lucerne paddock, and this part has been broken up, cropped, and resown. In resowing three varieties were used—Marlborough, Hunter River, and South African—and it is interesting to note that up to the time of writing the African appears to be doing the best. This area was sown down in November, 1931. Another portion of the older part of the paddock is being ploughed this current spring and will be resown with lucerne straight away without prior cropping.

In an endeavour to find another fodder plant to assist the lucerne in times of drought an area is to be sown down this spring with paspalum. This has provoked a great deal of adverse criticism in the district, but this valuable summer and autumn grass is deserving of a thorough trial.

The usual pasture top-dressing trials with various phosphatic, potassic, and nitrogenous manures were carried on during the year. These trials continue to prove interesting and are of considerable value to the district.

The dairy herd during the past season numbered sixty, and this, together with eleven heifers, thirteen calves, two bulls, and three horses, made the stocking of the 92 acres of the farm particularly heavy. Up to the end of March the butterfat produced constituted a record, but the dry weather then told, and the season's production finished up 288 lb. behind that of the best previous year, though 346 lb. ahead of that for 1930–31. The butterfat production per acre amounted to 174 lb.

The concrete silo is not proving very satisfactory. It has now been filled twice, and each time waste has occurred to a depth of several inches round the walls. Similar experience is common in the district. It would appear that the trouble lies in the thin walls, which do not prevent the great variation of conditions that occurs within and without the silo at times affecting the silage. Other concrete silos, with walls 6 in. thick, do not occasion the same trouble.

FARM DAIRY INSTRUCTION.

DESPITE the generally low prices received for dairy-produce, and the tendency to reduce expenditure in consequence (states the annual report of the Dairy Division for 1931–32), it is pleasing to record that during the year none of the dairy companies associated with the Department in the employment of the Farm Dairy Instructors gave notice to discontinue this service. This, in itself, is a striking testimony to the value of the work carried out by these officers. In all, thirty-one Farm Dairy Instructors have been employed by seventy-seven dairy companies with 26,596 suppliers, and these companies have forwarded 59,071 tons of butter and 31,282 tons of cheese for grading. As there are approximately 64,000 suppliers to dairy companies, it will be seen that half this number receive little or no instruction in the care and handling of the raw material, which is so essential to the maintenance of the desired quality. As the present adverse economic conditions preclude the institution of farm dairy instruction on a national basis, factory-managers whose suppliers are not included in the voluntary farm dairy instruction service need to do what is possible to improve the milk-supply through careful examination of the milk at the receiving-stage, and by affording where possible the necessary assistance to their suppliers of faulty milk.

Importation of Live-stock into New Zealand.—The prohibition imposed on cattle, sheep, and swine from Britain as a precaution against the entry of foot-and-mouth disease is still in force, and the only countries from which stock may be imported subject to the regulations are: Cattle from Tasmania, Canada, and the United States (with the exception of California); swine from Australia (with the exception of Queensland and Western Australia) and Canada; and sheep from Australia (with the exception of Queensland and Western Australia). Importations of cattle from the United States and Tasmania are subject to the precedent consent of the Minister of Agriculture in each case.

SEASONAL NOTES.

THE FARM.

Outstanding Importance of Proper Utilization of Pastures.

ALMOST invariably at this time of the year the feed available on pastures is in excess of the requirements of stock, and the task of major importance facing farmers is the effective utilization of the surplus growth. This being a bountiful season, the need for proper control of pasture growth is intensified. Consequently the scope is greater than usual for the employment of such measures as ensilage and "topping," which were described in these notes in last month's *Journal*.

While it would be unfortunate to minimize the importance of ensilage and topping as means of maintaining pastures in a vigorous leafy condition, it is very desirable not to overlook the fact that the grazier's principal tool is the grazing animal, and consequently that skilful manipulation of stock in grazing is of prime importance. On many farms this consists mainly in the adoption of a judicious system of rotational grazing. Essential features of such a system are (1) intensive in contradistinction to extensive grazing; (2) periodical, even, and fairly close grazing of fields; (3) spelling of fields for periods of substantially longer duration than the periods during which the fields are grazed.

Intensive grazing is effected by concentrating stock on the fields being grazed. For example, in dairying under a system of rotational grazing the whole herd is confined to one or two fields, and the remainder of the farm under pasture is thus spelled. As a rule, stocking at the rate of six or more cows to the acre constitutes intensive grazing. Ordinarily in dairying a field should be stocked heavily enough to bring about periodical grazings of not more than two to three days' duration. To fields which are grazed for periods of longer duration there often attaches, towards the end of the periods, a staleness which detrimentally affects the animals.

While a field needs to be eaten down evenly and fairly closely before stock are transferred from it, it is important to remember in practice that both punishment of stock and punishment of swards need to be avoided. In his zeal to effect even, close grazing a farmer may readily overreach himself, and in this connection the degree of closeness which is usually advisable has at times been exaggerated. If the stock consist principally of cows in milk it will be necessary to transfer them from a paddock early enough to avoid any undesirable falling-off in production that would be brought about by keeping them longer on the paddock. At times, especially if droppings have not regularly been distributed, this involves transferring stock from a field before patches of ranker growth are eaten down. It is highly desirable to remove without delay the tall growth from such patches. This may be done either by the employment of dry stock to continue the grazing of the field immediately the milking stock have been removed, or by topping of the rank uneaten patches with the mower. Dry stock, to be effective for this purpose, must be available in numbers sufficient to lead to the eating down of the rank patches within a few days, and as often the stock are not available in such numbers then topping needs to be adopted.

Regular and thorough distribution of droppings by means of harrowing makes it much easier to maintain an even leafy growth over grassland during spring and early summer. It is advisable to endeavour to avoid harrowing grass just before a dry spell, for rain is needed to remove the soiling of the feed which harrowing at times brings about.

It is timely to consider that under certain circumstances close grazing of pastures, apart from the undesirable punishment of milking stock which

it is apt to involve, may lead to lowering of the yield of herbage. Such lowering of the rate of growth may occur not only during the critical dry period which frequently is experienced in the latter half of summer, but also later on and for considerable periods, especially if close grazing is practised repeatedly. A special endeavour should be made to avoid close grazing a short time before the customary dry summer spell, during which it is desirable to have the surface of the land covered as completely as possible with vegetation.

Stock should be returned to a field which has been spelled not necessarily when all other paddocks available for grazing have been eaten down in turn, but when the growth on the spelled paddock is at the stage best suited for grazing. For instance, on a farm on which ten paddocks are being grazed, one paddock may be ready for grazing again when only seven of the other nine paddocks have been grazed. In such a case the two ungrazed paddocks should be dropped from the grazing programme for a while, and a return made by the stock to the paddock which has so recovered from previous grazing as to be at the best stage for grazing again. It is of vital importance to drop promptly from the grazing programme any fields which in early summer are providing feed in excess of the current requirements of the stock. Good control of pasture growth at this period is of such value as to justify closing a field from grazing even though the manner in which the surplus growth on it will be used eventually is not determined. The dropping of sufficient fields from the grazing programme will ensure that the growth on the remainder is properly controlled, and it is better to achieve this, even if some feed on the closed-up fields is not used to the best advantage, than to face the alternative result—uncontrolled growth on all the fields under grazing.

Effective rotational grazing can be carried out without abnormally close subdivision of farms. This is indicated by the fact that highly satisfactory rotational grazing is being practised on farms consisting of from nine to twelve fields. During the season of rapid growth of pastures it is frequently advisable to return the grazing animals to a field after it has been spelled for a period of six to ten days, and if grazing is confined to four to six fields, each of which is stocked periodically for one to three days, then suitable periods of spelling are obtained for each field.

Possibilities of Summer Top-dressing.

At times, for the purpose of stimulating fresh leafy growth in the latter part of the summer, it may be an advantage to top-dress some of the pastures of a farm with superphosphate in early summer. It is to be expected that such top-dressing would prove most effective in districts in which a good deal of rain falls in December and January, and that as the December-January rainfall decreases it would decline in effectiveness as a means of obtaining additional late summer, leafy, fresh growth, until a point would be reached when it probably would not be worth doing. Areas from which hay or silage have been saved generally respond profitably to a December application of super, which is likely to lead to an increased production of leafy feed at a season when such feed is frequently in scant supply.

Ensilage.

Those desirous of obtaining full information about the best methods to employ in ensilage should consult Bulletin 146, obtainable free on application to the Department of Agriculture.

A common fault in ensilage is the development of too high a temperature in the freshly gathered green material. This is often associated with another fault, the harvesting of the material in too mature a condition, a fault which was discussed in last month's notes. Usually sufficient heat has been developed in stored green material when it commences to sink down relatively rapidly—more rapidly than settling down due merely to the

weight of the material. As a rule, the changes in the green material which result in the production of high-quality silage have taken place when temperatures in the vicinity of 100° F. have developed. At times, and especially in stack silage, such temperatures develop within a day after the gathering of the green material, and in such cases the storing of the silage may proceed daily. But at other times, and particularly when leafy watery crops are being handled and during cold or wet weather, the rise in temperature may occur more slowly, with the result that it becomes advisable to allow two days, or even more occasionally, to elapse before more green material is added to that already in the stack or pit. On the other hand, if the material for silage is relatively dry and stemmy, and particularly if the weather is fine and warm, overheating is likely to occur unless additions are made daily to the green material already gathered. Usually daily additions of 4 ft. to 6 ft. in height, according to the condition of the green material, give good results. Development of heat is slower in pits and trenches than in stacks and slower in sappy leafy material than in stemmy material.

Haymaking.

The loss of valuable nutriment which is bound to occur in haymaking may at times be considerably reduced by good management. The loss, being largely invisible, often receives less consideration than it warrants, and it is likely that if farmers realized more fully how great the loss may be they would take more pains to reduce it. It was stated in a recent number of the *Journal of the Ministry of Agriculture* (England): "Even under good conditions at least 20 per cent. of the original dry matter of the grass is lost in the process of haymaking. . . . When bad weather occurs the leaching of the food nutrients by rain may account for the loss of 50 per cent of the dry matter, and when hay is stacked in poor condition further serious loss of nutrients and deterioration of feeding value occurs in the stack." There is no evidence or ground for believing that the position is substantially different in New Zealand from that in England.

Frequently, in an endeavour to have the haymaking coincide with a period of fine weather, the mowing is carried out too late, and an inferior hay, due to the stemmy character of the material, is necessarily secured. The advantages of mowing at the leafy, early flowering stage of the bulk of the material are so great that they warrant special measures in an endeavour to save the hay in good condition. Cocking is one of these measures. Over a considerable portion of the Dominion it is seldom possible to save a heavy crop of hay in really good condition without cocking. There is vital practical difference between a well-hearted and raked hay-cock and a mere heap. The heap becomes sodden when exposed to rain, but the efficiently built cock will shed much of the rain and be wet only on the outside. Cocking is particularly serviceable in the saving of lucerne and of clover hay of good quality.

If a period of rainy and unsettled weather occurs immediately after an area has been mown, then, within reasonable limits, the mown material should not be handled until fine weather seems to have returned; any handling that mown material receives increases the amount of nutriment washed out by the rain.

Convenience is only one of the matters which should be considered in selecting the site of a haystack. A good site is well drained and not unduly shaded in a way which is likely to reduce the drying influence of winds. A dry base for the stack should be secured by the use of such material as posts, rails, or branches of trees. High stacks have the advantage of giving a large amount of hay in proportion to the roof, but the task of raising hay to the top may become unduly great, especially when only manual labour is being employed. Relatively long narrow stacks are often to be preferred, because they favour the more ready drying and cooling of the material.

The best time to mow lucerne cannot always be determined by the flowering development. Safer guidance is provided in the development of basal shoots. When fresh shoots at the bases or crowns of the plants are about an inch long the lucerne should be mown.

General Cropping Work.

Over wide areas good results have been obtained consistently by sowing swedes in December. Almost invariably swedes are sown on land ploughed out of grass. This is quite sound practice in view of such diseases as club-root and dry-rot, and it is instructive to note that in the relatively few instances in the farmers' field competitions in which swedes followed swedes the resulting crops were generally comparatively poor. Where it is proposed to sow swedes after a previous swede or turnip crop it is advisable over wide areas in which club-root is common to use a variety such as Hernings, which has been shown to be resistant to club-root. It is also specially desirable not to employ an acid manure, such as superphosphate, alone, which favours club-root.

Apart from conditions in which there is reason to anticipate trouble from club-root, superphosphate is a good dressing for swedes; indeed, a dressing consisting of about two parts super and one part bone manure is widely used with good results at the rate of 2 cwt. to 3 cwt. an acre. It is well to bear in mind that super readily causes serious injury to swede and turnip seed if brought into close contact with it even for a short period. Apart from such injury, super is over wide areas the most efficient form of phosphate that can be used with these crops. The injury may be avoided by mixing super with an equal weight of carbonate of lime at least a week before sowing.

A standard practice which gives good results generally is to sow 8 to 14 oz. of swede seed per acre in rows 14 in. apart. The varieties of swedes which are popularly favoured are Superlative, Grandmaster, Masterpiece, and Magnum Bonum, with Hernings coming into prominence where club-root is a consideration of moment.

Chou moellier has justly gained considerable popularity during recent years. A characteristic of considerable moment is its marked resistance to club-root. Because of this resistance it may safely be made to follow swedes, rape, or turnips which were attacked by club-root. Chou moellier calls for high fertility; it demands a soil of the type which would suit cabbage. If it is desired to grow chou moellier on inferior soils their fertility should be inproved, farm-yard manure being an excellent dressing for this purpose. If sown in October or November on fertile soils chou moellier is well adapted to provide feed in late summer. For winter feeding the crop may quite well be sown in December. A suitable sowing is 1½ lb. to 2 lb. of seed to the acre broadcast, or ½ lb. to ¾ lb. in drills 2 ft. to 3 ft. apart. The plant responds well to liberal use of fertilizers such as a mixture of super and blood and bone in equal parts; 3 cwt. to 4 cwt. per acre of this mixture may usually be applied with profit, and such a dressing may often advantageously be supplemented with 1 cwt. of sulphate of ammonia. Chou moellier is less subject to attacks of disease than other members of the cabbage family. It is distinctly suitable for cows, pigs, and poultry. Quite a number of successful sheep-farmers favour it for carrying sheep through the winter.

Maize and millet, to provide green feed, and lucerne often may be sown advantageously in December. On many farms intertillage and thinning of root crops sown in October and November is work which is also well worth doing in December. Spraying of potatoes with bordeaux is widely advisable in the coming month.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Cultural Operations.

THE moderate rainfall experienced generally during October made it desirable to keep cultural operations well forward; failure to give this work due attention is often reflected in severe dropping of fruits during November. Insufficient moisture, and consequently the lessened amount of soil food available for growth, creates a competition between fruit and foliage. The necessity of conserving moisture by systematic working of the soil need therefore hardly be stressed.

Provision for the cover-crop will now be under consideration, and it may be suggested that where cropping with lupins has been carried out for several years, and where local conditions permit, it may be wise to consider a change.

Thinning of Fruit.

The requirement of all markets for more moderate-sized fruits and the limited demand for oversized will probably have the effect of a modification in thinning operations to meet this general demand. This may be permissible with some varieties of apples such as Gravenstein, Delicious, and Granny Smith, also young vigorous Jonathan trees that produce a proportion of oversized fruits, but with heavy-cropping varieties any extreme modification would be inadvisable.

Grafts.

It will still be necessary to look over grafts from time to time and suppress growths on the stock. Where failures have occurred it will be desirable to allow those growths on the stock advantageously placed to persist, so as to permit of their being budded in the autumn.

Spraying.

With the acquisition of a more intimate knowledge of the efficiency of certain of the fungicides used and the more protracted period of their adhesiveness, there is a likelihood of modifications in the spray programme being undertaken. In those orchards where trees are not advantageously planted, however, having poor drainage and lack of soil aeration, or where the initial expression of fungus spores in the spring may be delayed owing to weather conditions being unfavourable for spore development, it would be a doubtful policy to make any decided alteration in a programme that has been found to be satisfactory over varied seasonal conditions in the past. It may be suggested as good practice for the orchardist to make a survey of the results of his spray programme, having particular reference to the temperatures and rainy periods experienced to date, and the measure of success in control of both insects and fungi.

Spraying operations for the ensuing month will be continued on the lines indicated in previous notes. Should any special trouble develop, such as a severe attack of leaf-hopper, red mite, mildew, or black-spot on pome fruits, when combination sprays are necessary, it may be advisable to seek the advice of the district Instructor.

A good general spray for pome fruits to meet most conditions is the following: Lime-sulphur, ½ gallon plus 2 lb. to 4 lb. finely divided sulphur, to 100 gallons water; arsenate of lead, 1½ lb. to 100 gallons water; spreader, ¾ lb. per 100 gallons; nicotine sulphate (if necessary), 1 pint per 100 gallons.

In some locations where red mite is severe summer oil, 1–80 to 1-100, will be requisitioned. Care should be exercised that a period of ten to fourteen days elapses between applications of lime-sulphur and oil.

Early varieties of stone fruits will be receiving their final fungal spray about three weeks before harvesting. Mid-season and late varieties will probably still require the addition of nicotine sulphate where aphis is

troublesome and previous sprays have not been effectual; lime-sulphur 1 to 170 or colloidal 2 lb. to 100, is recommended in the latter instance: a weaker solution may be used in the former.

—H. F. Frost, Orchard Instructor, Wanganui.

Citrus Culture.

One of the most important operations in connection with lemon orchards is spraying for the control of the various diseases. Verrucosis and grey-scab can only be controlled by using bordeaux 4–4–40, and this should be applied at regular intervals, commencing as soon as the first fruits have set and repeating at intervals as required. In preparing the bordeaux care should be taken to have the correct blending of the two ingredients. In making up 40 gallons possibly the easiest and simplest way is to dissolve the bluestone into 36 gallons of water, and then slake the lime into 4 gallons and strain this slowly into the copper solution while the agitator is going. Do not dissolve the bluestone into, say, 4 gallons of water and the lime into 4 gallons, and then blend them together, adding the bulk of the water afterwards. It is necessary to dilute either the suspension or the solution first, and blend afterwards. Failure to get results is often caused through neglecting to blend the two ingredients together in the proper manner.

A summer insecticide for the control of scale, &c., will be necessary, and one of the summer oils can be used for this purpose. Where scale insects have been very troublesome two applications may be necessary in order to get a good control. These should be applied during the period of early growth.

Cultivation should not be neglected, as it is important to conserve all the moisture possible in case of a period of drought. A well-cultivated orchard during the spring and early summer reflects credit upon the owner, and the tillage is in many ways beneficial to the well-being of the trees.

A good look-out should be kept for any borer that may be in evidence and treatment given as indicated in the August notes.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Precautions against Vermin.

As the season has now arrived when hot weather may be expected, it is essentially a time when every effort should be made to prevent insect pests becoming established, for it is during hot weather that they are apt to show up and increase at an alarming rate. If these pests are not kept in constant check the health of the birds, as well as their egg yield, will suffer. The best method of dealing with vermin is to prevent them from making their appearance. This implies strict attention to cleanliness, the provision of good dust-baths, periodical spraying of the houses with strong disinfectant, and the application of nicotine sulphate to the perches.

Broody Hens.

Another detail that should not be neglected now is that of keeping the nest-boxes free from broody hens. To allow these birds to sit on the nests for days and weeks at a time not only encourages the presence of vermin, but also a loss in eggs and reduced profits. The houses should be visited nightly, and any birds found on the nests should be removed to the broody-coop. In this way the bird will usually lose the desire to sit in the course of a few days and will resume laying again in a minimum

of time. On the other hand, if the bird is not removed from the nest during the first stages of broodiness it may be a matter of weeks before a normal egg-laying condition is regained. A broody-coop should be made in three compartments, one section being allowed for each day's broodies. The bottom should be made of narrow battens about 2 in. apart and raised on legs about 8 in. from the ground. Thus, with a free circulation of air in the coop, the bird is unable to retain heat, and the broody fever soon becomes broken. The coop should be so arranged that the birds can secure their food and water from outside. The common cruel practice of starving the broody hen, or supplying her with a mere living diet should not be resorted to. If eggs are to be produced by her within the shortest period, ample food of a nourishing nature should be provided.

Marking Chickens.

There should be no delay now in marking the feet of chickens for age determination. It is the only safe means whereby the common mistake of disposing of young profitable birds at culling time, and retaining on the plant old unprofitable ones, may be obviated with certainty.

Care of Incubating Machines.

Many incubating machines, including even those of the most popular makes, are often condemned as unreliable because a uniform degree of temperature cannot be maintained in them. The explanation is often a simple one. It is that the screw-part of the connecting-rod between the thermostat and the arm carrying the disk, becomes bent, thereby making it impossible for the disk to respond as it should. The connecting-rod must be absolutely straight, otherwise the apparatus will not work with the necessary exactness. If there is any kink at all in the connecting-rod, the pull will not be direct, and therefore the disk will not rise and fall in complete harmony with the thermostat. Once the screw part of a connecting-rod becomes bent it can never be depended upon, and the only safe course is to take it out and put a new one in its place. No doubt carelessness is mainly responsible for connecting-rods becoming bent, as well as other parts of the regulating devices of incubators getting damaged beyond repair, and it may be the result of throwing things in a careless manner on the top of the machine during the off season.

It is surprising the number of people who fail to realize the amount of time and money that can be easily lost as a result of not giving their incubator proper care and attention when out of use. Instances could be multiplied where planned hatching operations have been upset or abandoned for the season because a duplicate for some damaged part could not be procured when required. The careful poultryman, as soon as the hatching season is over, thoroughly cleans and disinfects his incubators before putting them aside. The lamps as well as the burners are washed in boiling water, and the regulating appliances are disconnected and placed inside the machine. In this way there is not only the assurance that these parts will be in good working-order when required the following season, but the life of the incubator or brooder will also be greatly prolonged.

Non-absorption of Yolk in Chicks.

A correspondent reports that he secured a good hatch of chicks from his incubator, but that the great bulk of them died during the brooder stage through failure to absorb the yolk of the egg which is drawn into the body of the chick just before it leaves the shell. It is generally believed that failure to digest the yolk is due to feeding the chicks too soon after hatching, or to overfeeding during the first week. It is also often considered that breeding from overfat hens is responsible for the trouble. These factors may have some influence in regard to non-absorption of the

yolk, but experience goes to show that it is due more to improper incubation than to any other cause. This is borne out to a great extent by the fact that the trouble is seldom found in chicks that have been hatched by the natural mother. There it will be found that the yolk in its sac is in a more or less liquid state, which enables it to run freely and finally become absorbed. With incubator-hatched chicks the chief weakness probably lies in having the temperature too high during the whole or part of the incubating period, thus causing half-baking of the yolk and rendering it incapable of absorption. Evidently this is what happened in my correspondent's case, as he assured me that the chickens referred to commenced to pip on the nineteenth day of incubation and were hatched out on the following day.

If such trouble is to be minimized it is of the first importance that every care should be taken to prevent an excessive degree of temperature at any time during the incubation process. It will usually be found that really good hatches of chicks, which prove easy to rear, are obtained only when all the hatchable eggs pip on the twentieth day and the hatch is cleaned up on the twenty-first day. The temperature at the level of the tops of the eggs on the tray should be about 102° F. the first week, 103° the second and third weeks, and 104° when hatching. If the breeding-stock are all right, the eggs fairly fresh, the thermometer kept on a level with the germs, which are always floating uppermost irrespective of the position in which the egg is resting, and yet the hatch comes too soon or too late, it is well to have the thermometer tested or to secure a new one.

How to test a thermometer: Place a clinical thermometer and the one to be tested in water at 100° F. Stir gently, adding slowly at the same time hot water, and observe the different readings. If the incubator thermometer reads, say, a degree lower or higher than that of the clinical thermometer it must be worked a degree higher or lower accordingly.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Artificial Increase.

MANY methods are in vogue relative to what is commonly termed "increase." The word in this case means adding to the number of colonies. Strong stocks are built up by early feeding, and then are divided, the portion containing the old queen being removed to a new location. As nearly as possible an equal part of brood and stores is given to each, and the remaining space is filled with frames of foundation. Early queens must be reared and introduced to the half that is queenless, or, failing this, a ripe cell should be inserted.

For rapid increase this method is perhaps the best known in bee-culture, and is highly recommended. Always remember a good spring is necessary to ensure the young queens mating in time. If a large number of colonies are required those already divided may be further fed with sugar syrup or sealed stores, until sufficient strength has been gained for a second division. Just here judgment is required as to whether some stocks are too weak for a second division, for only the very strong should be so broken down.

Queen-rearing.

During the summer months every attention should be paid to raising a stock of young queens to replace old and failing ones. Buying new queens each successive season is too expensive, and with a little attention and care good queens can be raised by the beekeeper in his own yard. An apiary should be requeened as a rule each year, and queens should not be tolerated for more than two seasons at the most. In the long run it is the queens that tell in the production of big crops, and unless the

beekeeper takes the trouble to requeen in the summer only a small proportion of the stocks will yield a surplus. Perhaps no branch of apiculture receives less attention than the production of young queens; and yet if the beekeepers who get the big crops of honey are asked what counts most in their production the reply is invariably "young queens." In New Zealand it has been proved over and over again that the best period for raising queens is from November to February. During these months everything is favourable for the operation, as the hives are at their highest state of prosperity, and under normal conditions the workers and drones are at their best.

It is best to breed only from pure Italian queens whose correct mating has been assured. Novices can judge the mating by noting the uniformity of the hatching brood as regards colour. Should the young worker bees show diversity of colour—some being yellow-banded and others quite black—the mating has not been correct. The question of mating is always a difficult one, as queens mate on the wing, and therefore it is impossible for the apiarist to select the sires. But as purebred queens, even though mismated, throw pure drones, it only takes a comparatively short time to eliminate crossbred drones from an apiary. There is, however, still the chance of contamination from other drones in the neighbourhood.

To sum up the matter: By persistently breeding from the best it is possible to achieve wonderful results, while under careless management, or, as is often the case, no management at all, bees are sure to deteriorate.

Methods of queen-rearing are legion, but may be roughly divided into two classes—namely, those which use the naturally built queen-cells, and those which necessitate the provision of artificial queen-cups into which young larvæ are transferred. The former method is most suitable for beginners, or for use early in the season, as it minimizes the risk of chill to young larvæ; while the second method is used largely by beekeepers who want to rear queens in greater numbers.

The Alley System.—A simple, efficient, and easy method for raising queen-cells may be found in the Alley plan. It must be understood, however, that when raising queen-cells they require to be large and well-shaped, and that any cells not up to size should be cut out. Procure a frame of young larvæ from the breeding-hive, and with a sharp knife proceed to cut every second row of cells down to the midrib of the foundation. Next kill two out of every three larvæ, and cut the comb into strips about 1 in. wide the full length of the frame. These strips are fastened with melted wax to cell-bars that hang about midway in a standard frame. The cells are pared down to about $\frac{3}{8}$ in. in height, which gives the bees room to construct a solid base for the queen-cell. The frame or frames containing these bars, with the strips attached, may now be put into the hive previously prepared for their reception.

The Miller Method.—The Miller method of raising queen-cells will be especially useful to the novice or to the beekeeper wishing a few cells at one time. It is simple, easy, and under normal conditions never fails. No extra appliances are needed as previously described. Perhaps no better outline of the Miller system can be given than the original one which appeared in the *American Bee Journal* for August, 1912, as follows: "Into an empty brood-frame, at a distance of 2 in. to 3 in. from each end, fasten a starter of foundation about 2 in. wide at the top, and coming down to a point within an inch or two of the bottom bar. Put in the hive containing your best queen. To avoid having it filled with drone-comb, take out of the hive, either for a few days or permanently, all but two frames of brood, and put your empty frame between these two. In a week or so you will find this frame half filled with beautiful virgin comb, such as bees delight to use for queen-cells. It will contain young brood with an outer margin

of eggs. Trim away with a sharp knife all the outer margin of comb containing eggs, perhaps a few eggs next to the youngest brood. This you will see is very simple. Any beekeeper can do it the first time of trying, and it is all that is necessary to take the place of preparing artificial cells. Now put this 'queen-cell stuff,' if I may so call the prepared frame, into the middle of a very strong colony from which the queen has been removed. The bees will do the rest, and you will have as good cells as you can possibly have with any kind of artificial cells. You may think that the bees will start 'wild cells' on their own comb. They won't. At least, they never do to amount to anything, and, of course, you needn't use those. The soft, new comb, with abundant room at the edge for cells, is so much more to their taste that it has a practical monopoly of all cells started. In about ten days the sealed cells are ready to be cut out and used wherever desired."

Nucleus Hives.

In order to facilitate the work of queen-rearing a few nucleus colonies should be run in conjunction with every apiary. In these small colonies queens can be raised and cared for until they are mated and laying. It is an easy matter, once the queens are laying, to transfer them to the larger hives in the apiary.

The best style of nucleus hive to adopt is the four-frame one. This size will give the young queen a chance to lay once she is mated, and will, besides, hold sufficient bees to care for relays of queen-cells throughout the season. To form a nucleus colony take one frame of well-capped brood with adhering bees, and one frame containing honey and pollen, the remaining space being filled with an empty comb and feeder. If the number of bees on the comb is not sufficient to form a good cluster, one or two frames of young bees may be shaken into the nucleus, this being done to replace the field-bees which return to the old hive. Place the frame of brood in the middle of the hive and close the entrance until the following day, when the bees may be released. In the course of a day or two the small colony will settle down, and will then be ready to receive the first queen-cell.

Nuclei thus formed should be placed in a shady position until the bees are released. It is a good plan to set them a fair distance apart from each other and away from the main part of the apiary.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

As potatoes and other early crops are harvested, the land should be prepared for planting savoy and red cabbage, cauliflower and broccoli, brussels sprouts, leeks, and celery during the months of December and January.

Celery: Where the top-soil overlies a shingly open subsoil, and is overdrained in some instances at this season, celery should be planted out in prepared trenches. These are made 15 in. to 18 in. wide—the latter where it is intended to set a double row of plants. Lift out the black soil and place it neatly on each side of the trench in equal quantities; then dig the bottom well, and fill in with a rich mixture of decayed farmyard manure and soil; tread it firm, and finish off with 4 in. of good soil. This should bring the surface back almost to the original level. In two or three weeks, when the filling has settled down, it should be well watered shortly before it is intended to plant out. This should be done at the end of a dry spell, if possible, and just before a period when dull showery

weather may be expected. Prepare the plants by spraying them with bordeaux (this will not only prevent leaf-spot fungus, but also attack from slugs), and soak the boxes well with water the day before planting out. To do this lift the plants with a good ball of soil carefully, and plant them firmly 9 in. apart. Soak the trench well immediately planting is finished, remembering that celery is a water plant, and should never be allowed to become dry. In districts with a generous rainfall, and on land that is always moist but well drained, trenches are not necessary. The plants can be set out, in rich ground well prepared, in blocks of eight or ten rows 9 in. apart each way, with intervals between the blocks for access. This method is suitable especially for self-blanching sorts, or in rows 3 ft. or 4 ft. apart. The rows should lie north and south.

Brassicas: Where the brassicas—cabbage, kale, cauliflower, broccoli, brussels sprouts—are to be planted work in a good dressing of lime, and when the ground has settled set out the plants in dull weather, being careful to set them deep and firmly. While the plants are in the seed-beds prepare them for removal by spraying them with a mixture composed of three teaspoonfuls of nicotine sulphate, 2 oz. arsenate of lead paste, and 4 gallons water (rainwater for preference). Dilute each ingredient in a small bowl, and stir it well before stirring it into the bulk of the water, taking special care with the paste to see that it is all worked down into a smooth cream. This spray will prevent damage to the plants from the small green caterpillar larvæ of the diamond-back moth which eat holes in the leaves, and green aphides which suck the juices from the tender leaves of the heart of the plant, which they sometimes destroy completely. Fortified with this protection, the young plants have a much better chance of meeting their troubles successfully in the early stages of growth. If the beds are at all dry water them well the day before lifting the plants, and when planting out lift and handle the plants with the greatest care to avoid injury and wilting, and keep as many roots as possible intact. If this is done and the plants are properly packed in trays and placed in a cool shady position while awaiting transport, the serious losses often incurred will be avoided. Where large quantities are handled, or in instances where the plants have to be transported for some distance under difficult weather conditions, the roots should be puddled in a mixture of soot, clay, and cow-manure to prevent the plants drying out. If green aphis continues to be troublesome after planting out a little tobacco dust placed in the heart of each plant will make conditions so unpleasant for the pest that they will leave it. This danger only exists for the short dry period preceding the autumn rains.

Leeks: The leek is a most reliable crop which flourishes under almost all conditions. It is available over a long period; even well into the spring-time it retains its good qualities when many stored roots have to be discarded. In land rich in humus it should be planted out about 9 in. apart, with 15 in. between the rows. Plants about a foot high are best; trim the tops off lightly and set them in holes about 9 in. deep, made with a thick blunt dibble. Do not fill in the holes, just water the plants in; this method assists in developing a good length of blanched stems. The crop can remain in the ground until lifted as required.

Pests and diseases: If the summer should be dry there is danger of the potato-moth attacking the tubers, and plants should be protected by moulding them up with greater care. In the case of humid warm weather now, the late potato crop will be threatened with late blight, and a good bordeaux 4–4–40 spray should be applied and repeated after an interval of about a fortnight. At this season mildew is sometimes prevalent on vegetable crops of many kinds, and on its first appearance a liquid sulphur spray should be used. This is one of the many troubles harboured by some of the common weeds, which is another reason for their suppression, not

only in the crops but about headlands and odd corners. An easy method is to scythe them down before they seed. Yet another disease demands attention here, the bacterial wilt of kidney beans; there will undoubtedly be a considerable occurrence of this disease so difficult to control. Precautions that should be taken now are to avoid traffic through a crop while it is wet with dew or rain, to carefully burn infected plants, and to see that one does not carry infection on hands or clothing. The first visible sign of the trouble seems to be a light green or yellow spot with shaded outline on the leaf. The reddish lesions on the stems are very distinct, as are the raised pustules on the pods. Because of its infectious nature go through the crop frequently when it is dry, and carefully pull infected plants and burn them.

Small-fruit Culture.

The harvesting of strawberries, currants, raspberries, and other small fruits is now at its height, and in tarts or just with whipped cream and icing sugar they are daily "specials." On light land, especially in dry districts, a failing supply sometimes threatens. This may be overcome by spreading a light mulch of short strawy manure, lawn mowings, or something of the kind, and applying water freely.

Where land is being prepared for planting these crops during the autumn or winter, it is now probably carrying a crop of potatoes or other vegetables. Special care should be taken to cultivate the crop frequently so as to thoroughly clean the ground, as this will not only increase fertility but dispose of weeds, which are a serious menace where permanent crops are to be planted, particularly in the case of the strawberry crop.

The reports from the Cheshunt Research Station in England are always of interest to growers of tomatoes. An investigation concerning the reduction in yield of this crop by continuous cultivation in the same soil is reported in the last issue to hand. It shows that the reduction was least when the soil was maintained in a spongy and well-aerated condition. Crops improved after liberal soil treatment with green manures or plain straw. The straw was cut into short lengths and used at the rate of 6 tons per acre. After trenching it in, the ground was watered thoroughly and the usual fertilizers applied.

As a result of experiments for the control of tomato leaf mould, the following spray is recommended in the report: $\frac{1}{8}$ oz. Shirlan paste (salicylanilide dispersed in water as a 50-per-cent. paste), $\frac{1}{4}$ oz. Agral 1 (a spreading agent), 1 gallon water. The powder, Agral 1, is sprinkled into the water and mixed by stirring vigorously. Afterwards the requisite amount of Shirlan paste is added and mixed by stirring it well. A second application of the spray should be given seven days after the first, and further treatment if necessary. When the materials become available a trial under local conditions will be of great interest.

As a catch-crop under glass before tomatoes lettuce was grown at Cheshunt successfully during the past four years. The young plants were set out in unheated houses during December (June here), leaving room to plant tomatoes between the rows. The lettuce crop was removed within four or five weeks of planting tomatoes. The tomato plants were not injured by the presence of the lettuce, and, indeed, seemed to grow rather better. Tomato rows there were at a distance of 18 in. and 27 in. alternately; setting the lettuce plants 9 in. apart, three rows were planted in each of the wider spaces and one row in each of the smaller.

The Homestead Garden.

Choisya ternata is an evergreen shrub from Mexico that is very generally planted in our gardens. As it is said to be rather susceptible to damage at low temperatures, it is usually planted in a warm sunny position with very

poor results; the growth is crowded and dwarf, and the bloom small and scanty. Seen recently in a moist border lightly shaded, the plants were large open bushes with a mass of starry shining white blossoms that was most impressive. Camellias of different colours planted close by had the same light graceful open habit and generous display of blossoms that is such a striking contrast to the crowded, stunted, sunburnt growth so common when planted in sunny situations. This is a mistake we have made with many tender plants.

Where spring-flowering bulbs have to be lifted, it should be done so soon as the foliage changes colour and comes away easily when pulled. Place the bulbs in shallow trays and put them in a cool airy shed to dry and complete their ripening. Bulbs in grass should be scythed and mown so soon as they are ripe.

Mildew fungus has been troublesome in the garden for many seasons; roses and delphiniums among other plants are commonly attacked during the summer. A liquid sulphur spray is the most suitable means of preventing the disease from spreading.

The grass-grub will now be emerging from the ground in the form of brown chafer beetles during warm summer evenings. In districts where this pest is numerous lawns may be protected by broadcasting arsenate of lead powder 1 oz. to the square yard; it should be well mixed with fine soil. This material destroys the young larvae as soon as they hatch out from the eggs that are laid.

—W. C. Hyde, Horticulturist, Wellington.

FERTILIZER IMPORTATIONS: SEPTEMBER QUARTER.

FOLLOWING are particulars of importations of fertilizers into New Zealand for the quarter ended 30th September, 1932:—

Nitrate of soda: Chile, 190 tons. *Basic slag:* Belgium, 2,425 tons. *Char-dust and bone-char:* Australia, 20 tons. *Rock phosphate:* Ocean Island, 8,515 tons; Nauru Island, 53,320 tons. *Other phosphates:* United Kingdom 653 tons; Belgium, 404 tons. *Sulphate of ammonia:* United Kingdom, 2,320 tons; Canada, 180 tons. *Kainit:* Belgium, 40 tons; France, 25 tons; Germany, 27 tons; Poland, 105 tons. *Muriate of potash:* France, 5 tons; Germany, 60 tons. *Sulphate of potash:* Germany, 127 tons. *Other potash fertilizers:* France, 75 tons; Germany, 454 tons. *Sulphate of iron:* Australia, 2 tons. *Other fertilizers:* United Kingdom, 1 ton; Australia, 5 tons.

Correction: In the return for the June quarter, basic slag, 50 tons, shown as of French origin, should have been shown as of Belgian origin.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 22nd September to 3rd November, 1932, include the following of agricultural interest:—

No. 67819: Horse-shoe; D. P. Mahoney. No. 69223: Spraying-apparatus; D. R. Dowling. No. 69230: Manure-distributor; C. Oliver and R. T. Oliver. No. 67606: Fibre treatment; J. A. Douglas. No. 67658: Treating meat; W. A. Bowie. No. 67997: Composition for treatment of cows' teats; A. R. Thompson and E. I. Bullot. No. 68677: Milk-strainer; R. J. Carbines. No. 69244: Tying wool-bales; R. W. Monten. No. 64629: Three-way centrifugal separating-machine: J. E. Winsloe. No. 67467: Manure-distributor: E. C. Houchen. No. 69006: Cleaning wool; Frosted Wool Process Co. No. 69090: Disk plough; E. Reid. No. 69287: Pasteurizing-machine for dairy products; C. Doering and H. H. Doering. No. 67761: Drain-digger; E. W. Barnett. No. 67913: Handling wool; L. W. Bagley. No. 68065: Milking-machine; J. Taylor and Co., Ltd. No. 69256: Wool-baling press; F. A. A. Merchant and G. W. Dixon.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

"A CONSPECTUS OF RECENT AGRICULTURAL RESEARCH."

LORD BLEDISLOE'S CAWTHRON LECTURE.

IT was a happy and fitting thought on the part of the Cawthron Institute authorities to ask Lord Bledisloe, our much esteemed Governor-General, to deliver the annual "Cawthron Lecture" this year, and the choice of subject was no less appropriate. It is indeed difficult to think of any one better qualified than Lord Bledisloe to present a survey of agricultural research such as that now under review. He combines long experience in arable farming, live-stock raising, fruitgrowing, &c., on his own establishments in England, with scientific agricultural training, and has had active many-sided associations with public agricultural interests. Moreover, during his residence in New Zealand he has made himself well acquainted with our special farming practices and problems.

Lord Bledisloe's general approach to his subject may best be indicated by the following extract from the introductory passages of the lecture :—

"In no field of scientific effort is there to-day a greater, an economically more fruitful, or indeed a more well-balanced advance than in that which we designate collectively as Agricultural. In none, however, is progress so feebly recognized or its enormous commercial value so unjustly and short-sightedly underrated. Adjustments of the world's fiscal and monetary abnormalities may produce, at least temporarily, definite ameliorative results. But scientific discovery, prudently applied, will prove more permanently effective, both in augmenting the volume and improving the quality of the products of the soil, and in reducing, without human injustice, the cost of their production, transport, and distribution. This fact was recognized at the recent Imperial Economic Conference in the unanimous and prudent decision to perpetuate the existence of the Empire Marketing Board (of which I was myself one of the foundation members, as representing British farmers), and to provide for the continuity of its grants towards scientific research. And this leads me to the subject which I have chosen for this lecture. It is perhaps not unfitting that it should fall to me, however ill-equipped, to attempt in 1932 a summarized survey of the most striking results of recent agricultural research. Five years have now elapsed since I had the honour of presiding in Westminster Hall over the first Imperial Agricultural Research Conference, the main outcome of which was the establishment of Bureaux (or clearing-houses) for the dissemination and exchange, throughout the Empire, of the clearly ascertained results of scientific investigation and experiment, affecting different branches and phases of commercial husbandry, and during the interval which has since elapsed I have endeavoured, so far as my official duties have permitted, to keep *au courant* with such discovery, or amplified knowledge, as has from time to time emanated from the chief centres of specialized research in other parts of the Empire, as well as from those situate in this Dominion. I shall endeavour this evening to collate, without any attempt at an exhaustive or comprehensive survey, some of those which appear most interesting and most valuable in their potential economic effects."

The survey is divided into thirty to forty titled sections, some of the more important of which are those on soils, fertilizers, grassland, pasture research, mineral deficiencies, dairy research, wool,

types and fertility of farm animals, growth and meat production, fruit research, and agricultural economics. Grassland and mineral deficiencies, as might be expected, are discussed at greater length than some other topics. Regarding grassland, Lord Bledisloe remarks that "there is no field of research and experiment more closely affecting New Zealand husbandry, and none in which New Zealand scientists and farmers have more skilfully pointed the way to the rest of the Empire." Dealing with mineral deficiencies, he refers to "experiments at the Rowett Institute based on pioneer work in this Dominion." Dr. Leonard Cockayne and Mr. B. C. Aston are specially mentioned as pioneers in connection with pasture research and soil problems.

Concluding his survey Lord Bledisloe records a general appreciation of New Zealand workers in the field of agricultural science in the following graceful words: "I desire to pay a sincere tribute of appreciation of their public-spirited and efficient labours to the little band of scientific investigators who, in this Dominion, and with somewhat meagre resources (rendered more meagre by the prevailing economic cataclysm) are conscientiously and assiduously adding to the stock of human knowledge, and thereby to the real worth of their country and of the world. I congratulate them, and I warmly wish them in the future the full fruition and success which their public-spirited labours richly deserve."

It is obviously unfeasible to comment here in detail on the many-sided matter of the lecture, nor will space permit of further quotations, however tempting. Our farmer readers and others are recommended to go to the source themselves.

The lecture, the full title of which is "A Conspectus of Agricultural Research, with some Reflections thereon," has been published by Whitcombe and Tombs as a booklet of some sixty pages, well printed on good paper, at the popular price of one shilling. As a most interesting and informative collation, written in plain language and with a minimum of technicalities, it should certainly have a wide general circulation.

BOOKS RECEIVED.

LAND VALUATION AND PRICES IN NEW ZEALAND. By I. W. Weston, M.Sc., Ph.D., Lecturer in Farm Economics, Canterbury Agricultural College, Lincoln. Whitcombe and Tombs, Ltd., Wellington, &c. 3s.

TAXATION CONCERNING THE FARMER. By D. M. Malloch, A.R.A.N.Z.; with an introduction by I. W. Weston, M.Sc., Ph.D. Whitcombe and Tombs, Ltd., Wellington, &c. 3s.

CATTLE FARMING IN SOUTH AFRICA. By A. M. Bosman, Professor of Animal Husbandry and Dean of the Faculty of Agriculture, University of Pretoria. South African Agricultural Series, Volume X. Central News Agency, Ltd., Johannesburg, &c. 27s. 6d.

ROTHAMSTED EXPERIMENTAL STATION, REPORT FOR 1931. Lawes Agricultural Trust, England. 2s. 6d.

HEMP FIBRES: Twenty-fourth Report of the Imperial Economic Committee. H.M. Stationery Office, London. 6d.

San Jose Scale and Poplars.—The Orchard Instructor at Hastings, Mr. N. J. Adamson, reports: "In this district poplars have been discovered in several instances to be infected with San Jose scale (*Aspidiotus perniciosus*). The Lombardy poplar is used very extensively for orchard shelter in Hawke's Bay, consequently the matter of scale control becomes more difficult. In the past the poplar has never been suspected as a source of orchard infection, so this discovery may lead to the tracing of a good deal of orchard infection which could not be accounted for previously. Silver birch, which is also used to a fair extent for shelter, is also liable to scale infection.

WEATHER RECORDS: OCTOBER, 1932.

Dominion Meteorological Office.

OCTOBER was a particularly favourable spring month, the principal features of which were generally mild temperatures, a good rainfall in those districts where it was most required, and an absence of strong, drying north-west winds usually so prevalent at this time of the year. After a succession of dry, cold months, the rain came at a time when the soil was in an ideal condition to receive it, and, as a result, vegetation made phenomenal growth.

Rainfall.—The total rainfall was considerably above the average in the eastern districts of the South Island, parts of Canterbury having more than double the usual amount. It was also in excess over much of the Taranaki and Wellington Provinces, but elsewhere, except at isolated places, below normal falls were recorded. The deficiency was greatest in the Gisborne and Hawke's Bay districts in the North Island, and in Otago, Southland, and South Westland in the South Island, but even in these districts there were occasional useful falls.

Temperature.—Temperatures were nearly everywhere above the average, the departure being over one degree and, in places, up to two degrees in the North Island. In the South Island the western districts had much warmer conditions than usual, while in Otago it was slightly warmer; but in Canterbury it was again colder, although the difference from normal was nowhere great. No severe frosts occurred.

Sunshine.—Over the greater part of the Dominion sunshine was less than the average, the only meteorological stations with an excess being Auckland, New Plymouth, and Invercargill. The deficiency was small in the North Island and in Marlborough, but parts of Canterbury had particularly low aggregates.

Pressure Systems.—The month as a whole was free from severe widespread storms. During the first week an anticyclone ruled and fine pleasant weather was general. From the 7th to the 13th, a series of moderate westerly depressions crossed the Dominion and somewhat changeable weather was experienced, although rainfall during this period was confined chiefly to districts with a westerly aspect. After the 15th a succession of depressions, chiefly of cyclonic form, advanced over the Tasman Sea and New Zealand, and, except for a few brief fine intervals, the weather continued to be dull and unsettled until the 27th. Rain fell at times in nearly all districts, and between the 21st and 26th Canterbury received some heavy downpours with cold easterly to southerly winds. By the 28th the last of the series of cyclones had passed eastwards, and a westerly type of pressure prevailed from then until the close of the month. Rather widespread rain fell on the 29th, but on the 28th and the last two days the weather was generally fair.

Associated with a rather intense cyclone which moved across New Zealand on the 24th and 25th, there were thunderstorms in various parts of the northern and central areas of the North Island. A particularly sudden and heavy downpour of rain occurred in the Woodville district between 1 and 2 p.m. on the 25th. Also, between Warkworth and Mahurangi Heads on the morning of the same day, a tornado was experienced which unroofed buildings and uprooted trees in the district.

RAINFALL FOR OCTOBER, 1932, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average October Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	2·95	14	0·75	5·42
Russell	3·45	14	0·85	4·02
Whangarei	3·80	18	1·09	4·80
Auckland	3·33	16	1·25	3·72
Hamilton	2·31	13	0·53	4·67
Rotorua	6·57	17	1·41	5·24
Kawhia	4·44	17	1·01	5·18
New Plymouth	6·08	15	2·16	5·47
Riversdale, Inglewood ..	11·09	20	2·32	10·39
Whangamomona	8·06	13	1·21	8·45
Eltham	6·70	13	1·55	4·88
Tairua	4·80	15	1·22	5·86
Tauranga	3·78	14	1·02	5·31
Maraehako Station, Opotiki ..	4·18	17	1·02	5·30
Gisborne	1·31	10	0·63	2·70
Taupo	3·31	19	0·66	4·34
Napier	0·41	7	0·13	2·23
Hastings	0·41	8	0·13	2·18
Taihape	1·93	14	0·68	3·66
Masterton	2·44	10	0·95	3·30
Patea	5·36	14	0·83	4·20
Wanganui	3·48	13	0·58	3·46
Foxton	2·17	11	0·54	2·98
Wellington	3·87	14	0·85	3·41
South Island.				
Westport	7·51	19	1·12	8·70
Greymouth	9·88	20	1·96	10·32
Hokitika	13·65	19	2·29	11·83
Ross	13·20	15	2·41	14·84
Arthur's Pass	17·80	13	5·38	20·48
Okuru	7·01	7	3·50	15·60
Collingwood	7·02	15	1·25	10·27
Nelson	4·60	15	1·29	3·49
Spring Creek	4·19	18	1·27	2·50
Hanmer Springs	5·51	9	1·60	3·87
Highfield, Waiau	5·03	10	1·82	2·74
Gore Bay	5·96	10	2·18	2·11
Christchurch	4·96	12	1·13	1·69
Timaru	3·24	10	1·41	1·92
Lambrook Station, Fairlie ..	3·31	11	0·99	2·02
Benmore Station, Clearburn ..	3·11	9	1·38	2·27
Oamaru	3·04	13	1·02	1·73
Queenstown	1·46	9	0·40	3·41
Clyde	1·52	6	0·72	1·62
Dunedin	1·97	10	0·82	3·12
Wendon	1·80	8	0·55	2·79
Gore	1·68	14	0·41	3·28
Invercargill	1·53	11	0·54	4·50
Puysegur Point	5·86	17	1·27	8·26
Half-moon Bay	2·39	16	0·53	5·32

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.

RIDDING YOUNG PASTURE OF DOCKS.

A. T. BILKEY, Buckland :—

Can you advise me of a satisfactory method of getting rid of docks in a young permanent pasture ?

The Fields Division :—

Docks in young permanent pasture can be gradually diminished by the following methods : (1) Heavy top-dressing to strengthen the grass and clover plants, so that their increased growth tends to smother the dock. (2) Systematic grazing and spelling ; the pasture should be spelled as long as possible between grazings, commensurate with good utilization of the stock employed. (3) The grazing-down should be as rapid as possible ; day and night grazing with as large a number of stock as possible should be adopted. (4) Avoidance of close grazing. (5) Preventing the docks forming seedheads. Docks thrive best where the pasture is kept continually bare, allowing their leaves to lie flat on the ground. The methods of grazing advocated above, besides being of value in crushing out the docks, are also those most suitable to adopt in improving the pasture and the pasture growth.

JAPANESE MILLET FOR ENSILAGE.—LIME AND PUMICE SOILS.

" SUBSCRIBER," Wairoa :—

Please advise me on the following questions : (1) Would a crop of Japanese millet be suitable for making silage ? (2) Which would you recommend for pumice land—carbonate of lime or burnt lime ?

The Fields Division :—

(1) Japanese millet is not preferred for making silage, one of the chief reasons being that the stems are hollow, and owing to the presence of air the resultant silage is usually of poor quality. If millet is available and must be used, it is suggested that it should be mixed with material from a pasture containing plenty of clover. This method would aid in producing a better-quality silage, and a superior balance between carbohydrates and protein from a feed-value point of view.

(2) Pumice soils appear to vary in their response to lime in different localities, and so far little or no difference is noticeable between the effects of carbonate and burnt lime. The question mainly centres round that of cost. Approximately double the quantity of carbonate of lime is required to that of burnt lime.

CHICKEN WITH MALFORMED BEAK.

" AMATEUR," Auckland :—

One of a brood of healthy Rhode Island chicks I have found to have a crossed beak. The lower half of the beak protrudes ¼ in. beyond where the upper half crosses it, thus making feeding difficult. Can the fault be remedied ?

The Chief Poultry Instructor :—

Little or nothing can be done in such a case as this. A bird with a malformed beak should never be kept, as this defect prevents it keeping that provision of nature, the little oil-well at the root of its tail, clean and in working condition. The well dries up and becomes a home for insect life, and the bird, being unable to obtain oil for pluming itself or to use its beak for picking insects off its body, becomes a prey to parasitic life, and is not only in a state of torture itself, but spreads vermin wherever it goes.